April 1982
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How to Compare Risks, and How Not To

What to Do Before the Oil Runs Dry

Working at Home By Computer

Robbing Banks By Computer

Technology Review

Edited at the Massachusetts Institute of Technology

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review
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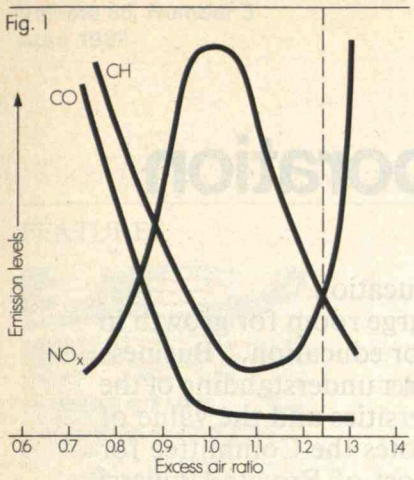
We believe that fuel injection, like front wheel drive, is a necessary component for any automobile that is truly of the '80s. We hope to explain why on the adjacent page. And, we also hope after reading it, you will agree.

How Volkswagens work:

Keeping an eye on the engine.

The fuel injection.

Fig. 1



It helps the Rabbit start up easily. Even at sub-zero temperatures. It permits the Scirocco to corner and act as a sportscar without fuel starvation. It gives the Jetta instantaneous power with no hesitations. It provides the VW Pickup with its remarkable, smooth performance. And, every one of these VW virtues owes its existence to the same reason. Fuel injection.

Fuel injection is nothing new to VW. It's been available on VWs since 1967. But even now, fuel injection is still a feature usually reserved for high performance luxury sedans and exotic sportscars.

How come? Simple. Fuel injection is the most direct and precise way to administer the optimum air and fuel mixture to an automobile engine.

The kind VW uses is the K-Jetronic Continuous Injection System (CIS). It has fewer parts than any other system in general use today and it is noted for its reliability, exceptionally clean burn (Fig. 1) and smooth performance.

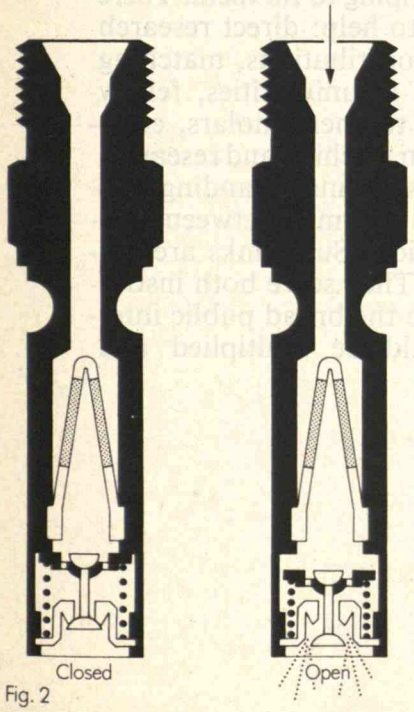


Fig. 2

How CIS works. With CIS, finely atomized fuel is continually sprayed directly into the engine cylinder entrances by individual injectors (Fig. 2). Inside each injector, a tension spring and pin assembly releases fuel in exact proportion to the measured volume of air entering the cylinder.

A fuel distributor (Fig. 3A), at the heart of the system, determines the precise amounts of fuel to be delivered to each injector by measuring the air flow in the intake manifold as it passes a floating sensor (Fig. 3B). The driver merely regulates the air flow with the "gas" pedal (Fig. 3C).

When the engine is turned off, the spring closes the injector (Fig. 3D) to shut off the fuel supply and reduce the chance of vapor lock. The positive shut-off also prevents engine run-on, a common problem with carburetors when the engine continues to run spasmodically after the ignition has been turned off.

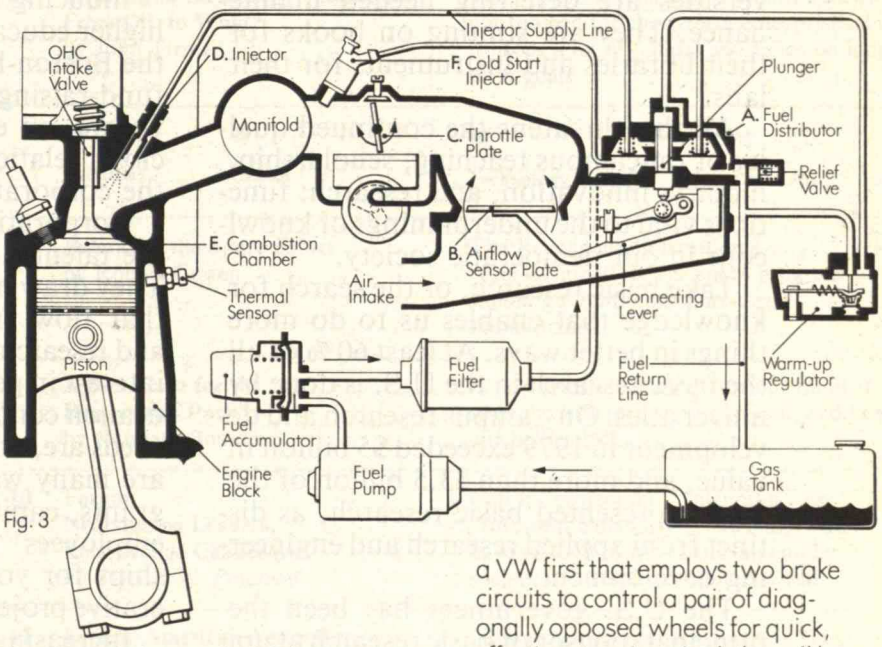


Fig. 3

CIS reliability. On VW's overhead cam engines, CIS is advantageous since it provides a consistently accurate fuel mixture to the rapidly opening and shutting valves. Even at high RPM. The combination of precise fuel metering, VW-designed intake ports (Fig. 3E) and the squish-type firing chambers results in a more complete fuel burn. Even with lower priced, lower octane unleaded fuels.

There's also a fifth injector (Fig. 3F) designed for cold starts. It's the reason VWs have the amazing ability to start up easily in very cold weather.

What you get with it. Now consider the unique packages of engineering the CIS comes in. The VWs themselves. All in all, a remarkable collection of nimble cars and trucks.

Each with a whole slew of features found here and there on today's "high technology" vehicles, but never all at once.

They have front-wheel drive for exceptional directional control even under adverse driving conditions. Four-wheel independent suspension with torsion stabilizing for positive road tracking and minimal body lean in tight curves. Rack-and-pinion steering for light, precise turning. Dual diagonal braking combined with negative steering roll radius, a VW first that employs two brake circuits to control a pair of diagonally opposed wheels for quick, effective stopping. And, they all have VW's own Formula-E Upshift Light System to help drivers develop sensible, economical driving habits.

Need we say more? We can. Easily. It's just that fuel injection, like everything else, is all part of what makes a VW a Volkswagen.

Nothing else is a Volkswagen.

Campus and the Corporation

There are growing grounds for concern about the health and vitality of higher education in America. Public and private universities face troubled futures rooted in fiscal uncertainties that strike at the heart of the educational mission.

Budgets and endowments are being ravaged by inflation. Faculty salary scales are under pressure; pay dropped by 20% in constant dollars during the last decade. Enrollments are on the decline, particularly in graduate studies. Bright young people are turning away from academic careers. With their budgets squeezed, universities are deferring needed maintenance. They are stinting on books for their libraries and instruments for their labs.

All this threatens the continued quality of on-campus teaching, scholarship, inquiry, innovation, and research: functions vital to the underpinnings of knowledge in our democratic society.

Take basic research, or the search for knowledge that enables us to do more things in better ways. At least 60% of all the basic research in the U.S. is done by universities. On-campus research and development in 1979 exceeded $5 billion in value, and more than $3.5 billion of the total represented basic research, as distinct from applied research and engineering development.

The U.S. government has been the principal sponsor of basic research at universities. However, government support has been weakening in recent years. One measure of hope is the increasing involvement of the business community in supporting university research and in contributing in other ways to the strengthening of higher education.

Still, there's large room for growth in corporate help for education. "Business has gained a clearer understanding of the role of the universities and the value of free inquiry," notes the Committee for Corporate Support of Private Universities. "One result is a substantial increase in business support of higher education — measured in inflated dollars. But in constant dollars, it has risen only marginally." What's especially disturbing is that many corporations give little or nothing to higher education.

Inducing more companies to support higher education is the task taken on by the Boston-based committee. It is not a fund-raising agency. Rather, it is an advocate, an exhorter, working to foster closer relationships between campus and the corporation.

Corporations turn to the campus for the talented, trained people they need. They draw on the ideas and innovations that flow from university scholarship and research. So business has a direct self-interest in getting closer to the higher education community, finding out what the needs are, and helping to fill them. There are many ways to help: direct research grants, capital contributions, matching employees' gifts to universities, fellowships for young teacher-scholars, cooperative projects in teaching and research.

Increasing ties of understanding and support are being formed between business and education. Such links are mutually valuable. They serve both institutions, along with the broad public interest. They should be multiplied and strengthened.

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Technology Review

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Who's to Be Taxed?

The disposal tax proposed by David Gordon Wilson in "Building In Environmental Costs" (*November/December, page 10*) is a regressive measure and unlikely to succeed. Government agencies usually use tax money to do what is best for their own departments rather than what is best for the country. Legislation enforced by EPA and other organizations has not accomplished much either, because the average person engages daily in a private cost-benefit analysis. Altruism will not motivate the masses, nor will a tax solve the problem. Industry is now rightfully compelled to bear the cost of handling the waste it produces.

Dudley Robinson
Chicago, Ill.

David Gordon Wilson responds:
Producing the proper incentives is exactly what the process of "internalizing externalities" does. Industry does not bear all the cost of handling the waste it produces. If it did, the problems would be solved very quickly and government would not need to get involved. We need impregnable trust funds such as the Highway Trust Fund, which has resisted all raiding parties for decades, to have truly "closed-loop" redress of environmental and other grievances. Pollution taxes are by no means regressive. Making the rich pay more would in fact be progressive. The key is who benefits from *receipt* of pollution taxes or the replacement of any existing taxes. When private decisions taken for personal benefit simultaneously benefit the public, our national prosperity and sense of well-being improve dramatically. Internalizing external costs does just this.

Controlling CO_2 Buildup

Don Scroggin and Robert Harris in "Reduction at the Source" (*November/December, page 22*) and Lester Lave in "A More Feasible Social Response" (*page 23*) neglect the most attractive alternative available to society to control atmospheric carbon-dioxide buildup: a sequential decision-making process. We need a national policy that favors timed development of suitable technologies. We should gather more accurate information about the distribution and timing of CO_2 buildup, its influence on the economy, and the various options to increase productivity under these conditions. By arguing that their policies are "desirable in their own right," these authors lose sight of the key issue currently facing society: deciding how much to spend now. Large investments are justifiable only after an assessment of their costs and benefits.

Robin Sanderburg and John Hoffman
Washington, D.C.

I am following the problem of atmospheric CO_2 buildup closely, since my Cape Cod house will float away if "sea levels rise five to eight meters." I think the problem can be solved by economics. Eventually coal will become too valuable to burn; it will then be used mostly as a feedstock for the production of chemicals.

James L. Gurney
Osterville, Mass.

More on Hazardous Waste

In a table in "What to Do with Hazardous Waste" by Selim Senkan and Nancy Stauffer (*November/December, page 38*), the leather tanning and finishing industry's solid wastes are erroneously mentioned as hazardous. In the early years of the Resource Conservation and Recovery Act, the U.S. Environmental Protection Agency made a number of ill-founded decisions on potential solid-waste hazards. The EPA recognized this error and deleted the leather and finishing industry from the list of hazardous wastes.

Robert M. Lollar
Cincinnati, Ohio

Selim Senkan responds:
Mr. Lollar is right. As of October 30, 1980, the EPA excluded the leather tanning industry from this list. We were unable to include this amendment in our article because of the timing of publication. As we mentioned in the article, EPA's official list of hazardous wastes is constantly changing, and we would like to alert our readers again to this situation.

Diversity in Space Industrialization

The October issue on the space shuttle's impact on space industrialization illustrates the problem of a lack of conceptual diversity in developing world-scale technologies. There are at least seven alternatives to the conventional rocket. The rail gun and mass driver use powerful magnetic fields for ballistic propulsion. Laser or particle beams

might also be considered. So-called "exotic" fuels (involving unusual, highly unstable compounds of lithium and boron) can deliver incredible thrust. Could advances in microprocessor-based monitoring and control systems make these exotic fuels safe enough to use?

Nuclear power would be a fifth possibility if there were guarantees against radioactive contamination. A sixth alternative is electrostatics. A large, thin metallic disc might sail the earth's magnetic currents and could venture out into the solar atmosphere as well. Finally, gravity itself could prove to be exploitable.

The shuttle's advantages over other conventional rocket-based approaches to space travel are clear. But alternatives to the fundamental assumption have never been adequately tested.

Paul C. Kainen
New York, N.Y.

Right Place at the Right Time

Regarding Robert Cowen's "Federal R&D: Let Them Eat Seedcorn" (*August/September, page 8*): no matter how valuable certain research, funding is likely only if the research has value in the eyes of taxpayers and Washington. Funding can be acquired by constructing a hierarchy of values, so one can determine what efforts to put where and when. But this won't work unless good public relations is one of the main elements of the system.

David A. Freiwald
McLean, Va.

Cancer Risks: All in the Mind

One had to trek through nine pages of Edward P. Radford's "Cancer Risks from Ionizing Radiation" (*November/December, page 66*) before reaching a main point concerning radiation risks: that "the health risks from exposure to ionizing radiation have been exaggerated in the minds of the public." In early 1978 the radiation controversy was ignited by a local newspaper report that the nuclear workers at the Portsmouth Naval Shipyard (PNS) had twice the death rate from cancer as the general public, and a leukemia death rate of 450 percent above the general population. The flames of controversy were fed by Dr. Thomas Najarian in the November 1978 *Technology Review* (*"The Controversy Over the Health Effects of Radiation"*) and when he appeared before several antinuclear groups. A million dollars and three years later, the National Institute of Occupational Safety and Health concluded that "no relationship between exposure to radiation and mortality from any cause was observed among the PNS population when compared with the U.S. white male population."

These findings were never clarified, nor has the fact that Dr. Najarian withdrew most of his claims before Senator Edward Kennedy's Subcommittee on Health and Scientific Research in June 1979 ever been publicized. Unfortunately, most of the harm has already been done. Scores of blue-collar workers are not afraid to smoke two or three packs of cigarettes a day, but they are scared to work with anything nuclear or even receive routine medical x-rays.

Donald A. Dube
Albuquerque, N.M.

Thomas Najarian responds:
Although Mr. Dube is correct in stating that the National Institute of Occupational Safety and Health (NIOSH) has published an analysis of mortality at the Portsmouth Naval Shipyard stating that there is no increased risk of cancer for nuclear versus nonnuclear workers, several of the NIOSH consultants, as well as myself and Dr. Theodore Colton, do not agree. If one performs an analysis that NIOSH failed to do, one finds a statistically significant relationship between hematologic malignancies and radiation dose among nuclear workers. Those nuclear workers with the highest exposure (generally 1 to 5 Rems of lifetime exposure) had three times the risk of dying of hematologic cancer compared to nuclear workers with little or no exposure.

If this relative risk is confirmed by additional studies, then the BEIR III Committee mentioned by Dr. Radford underestimated the risk of today's nuclear workers by a factor of 10 to 20 (the same figure that I estimated in the 1978 *Technology Review* article). With the higher estimate, the risk of death from cancer for today's nuclear worker with a lifetime exposure of about 25 rems would still be an order of magnitude less than the risk from cigarette smoking.

Playing for Time

Kenneth Boulding's "Bargaining for What?" (*November/December, page 4*) reminds me of questions about the interplay of various interests in collective bargaining. Several years ago A.H. Raskin reported that a labor leader was being repeatedly pressed by workers into opening contract negotiations with demands he considered excessive. To his consternation, whenever he did so, management acquiesced with only a semblance of resistance. He confided to Raskin his worry that management was making commitments their companies would eventually be unable to sustain. The depressed state of many industries today may largely be the cumulative effect of such settlements.

Management representatives can foresee the consequences of accepting excessive demands even better than labor representatives.However, implementation of the provisions of a new contract usually takes place over several years, with the full effect delayed even further. On the other hand, the effects of a strike are almost immediate. Reduced earnings occur in the next few quarters, and the owners might call for new management when they see the market value of their shares dwindle. Management representatives thus protect their own interests by avoiding a strike rather than opposing demands they know to be destructive to the long-range interests of the company.

Mark Smith
Sharon, Conn.

Hardheaded Software

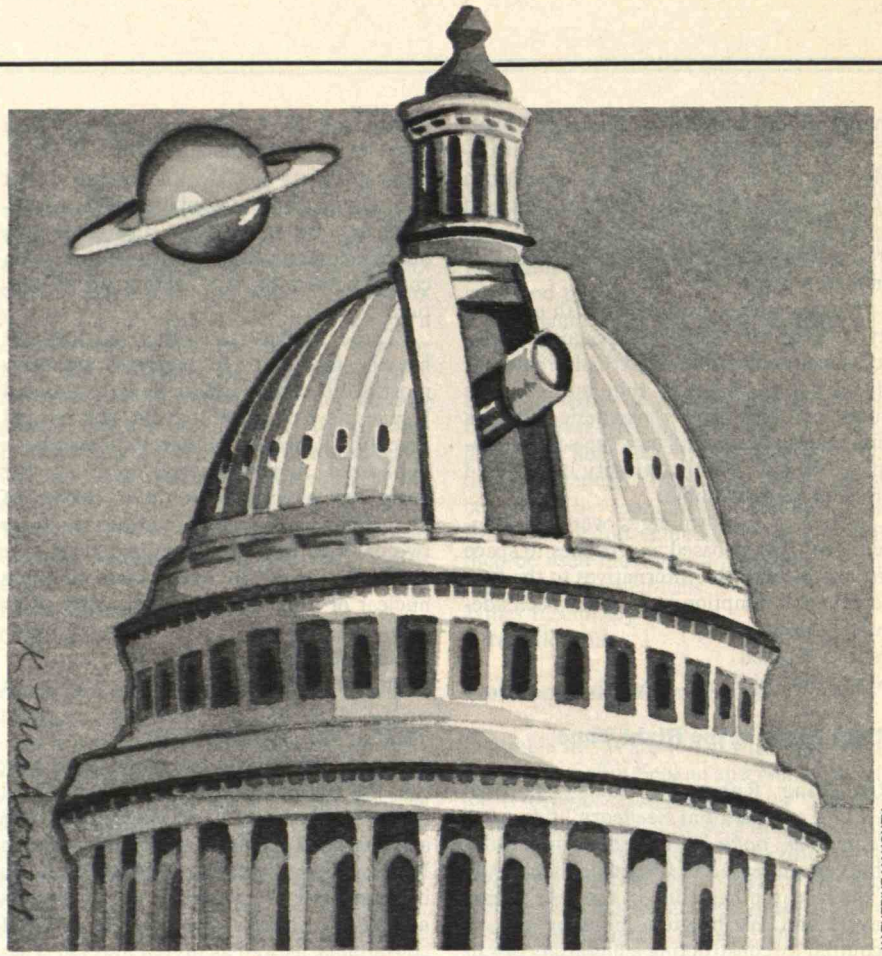
Robert Cowen in "Cottage Computing: Glorifying the Trivial" (*November/December, page 6*) misses at least one critical point. The home computer is more than just a contraption to glorify the trivial. Given proper design, electronic display of a newspaper won't strain the eyes. "User-friendly" computers would be a pleasure to use. There is no reason for anyone to put up with an idiosyncratic, cranky system, whether the person is a data-processing professional or a "civilian" dealing with a home computer.

Jeffrey L. Star
Santa Barbara, Calif.

Editor's note:
We failed to mention in the January 1982 issue that an extended version of "How to Resolve Environmental Disputes Out of Court" by Lawrence Susskind and Alan Weinstein appeared in the June 1981 issue of the Boston College Environmental Affairs Law Review.

Robert Cowen

Balancing the Space Effort



KATHERINE MAHONEY

An old adage holds that the difference between affluence and poverty is the difference between spending one penny less than your income or one penny more. However, for U.S. space science, the difference is about 10 percent of the space budget—roughly the cost of two B-1 bombers—and still rather trivial in the scale of national expenditures, according to Frank Press, president of the National Academy of Sciences.

That is the perspective in which he urges one to view the U.S. space program at a time when it is undergoing a rebirth. George A. Keyworth, director of the White House Office of Science and Technology Policy (OSTP), is heading a thorough study of that program designed to give it a new direction for the 1980s. Speaking during a panel discussion at the 1982 annual meeting of the American Association for the Advancement of Science (AAAS), Dr. Keyworth said: "It is now time for a major reassessment of the U.S. space program to evaluate our potential for new space activities and choose among our options. . . . The 1980s will be a time to develop and pursue a new and realistic outlook for space."

Dr. Press, as part of the same panel, expressed a concern widespread among U.S. scientists that short-term economizing should not dominate this reassessment. The U.S. space science effort, he said, should not be the subject (or victim) of an annual budget debate—it should be viewed as part of the ongoing history of the world.

Space Telescope vs. Planetary Exploration

Although veiled somewhat by executive secrecy, a major debate about the U.S. space effort is indeed underway within President Reagan's administration. There is little doubt that 1982 is a year in which decisions will likely be made that will determine the course of that effort through 1990, perhaps even for the rest of this century. There is also little doubt that the scientific community is bringing the pressure of well-reasoned arguments to bear on the administration, and on Dr. Keyworth in particular, to moderate what many scientists perceive as hostility toward plantary exploration and a bias toward the space shuttle that could seriously weaken U.S. space research.

Obviously sensitive to the alarm within the scientific community, Dr. Keyworth said that he had yet to hear a rumor from that community that "bears any resemblance to [the] reality" of that budget. He did not elaborate. But he did lay one fear to rest—that the *Voyager II* spacecraft would be shut down and the Deep Space Tracking Network inactivated before the spacecraft could give humanity its first close look at Uranus, and perhaps even Neptune. The tracking and data-acquisition network will still receive support. "We throw away billions for want of a few million by not funding such actitivies," Dr. Keyworth said. He added that is "unacceptable" to the Reagan administration.

Dr. Keyworth has a public image among scientists as an "enemy" of planetary exploration. As evidence of this, he is widely reported to believe that the Space Telescope can substitute for planetary missions throughout this decade. Space Telescope is an orbiting observatory to be lanched by the reusable space shuttle within a few years. It should boost astronomers'observational power by an order of magnitude or more, but planetary scientists do not consider it a replacement for close-in surveys by spacecraft.

Dr. Keyworth, stung by this reputation, said he feels frustrated when he says nice things about Space Telescope that are interpreted as disenchantment with space science. Calling planetary exploration "the single most exciting element in the space program of the past ten years," he said the administration wants "balance" in the space effort. He implied that this should include planetary exploration. But with the cost of individual planetary missions approaching a billion dollars each, the ability to maintain a flexible space program is being eroded, he said. What is needed, he added, is a new approach to planetary exploration featuring missions with individual price tags of only a few hundred million dollars. Such a planetary-exploration strategy already is under study both by an advisory committee of the National Aeronautics and Space Administration and the National Academy of Sciences.

Dr. Keyworth's remarks do bring some comfort to the planetary science community. One knowledgeable observer explained: "He has softened his position. He had

wanted a ten-year moratorium on planetary exploration. Now this at least means Galileo is safe." Galileo is a mission, now in advanced preparation, that would place a spacecraft in orbit around Jupiter and send a probe into its atmosphere. This is the only major new planetary mission now authorized for the U.S., and the prospect of its loss has plunged planetary scientists into despair.

In the lexicon of journalism, "knowledgeable observer" means "I can't quote him directly without violating a confidence, but he is very well placed and knows the score." The fact that such an observer senses a softening of a very hard position within OSTP against planetary missions suggests that a productive dialogue between the Reagan administration and the U.S. scientific community is beginning.

Joint Investments for Sound Returns

Indeed, speaking in the larger context of U.S. science policy generally, Dr. Allan Bromley, AAAS president, said that such consultation is starting to occur at many levels. For a year, many scientists had watched in horror as budget cuts were made without sound understanding of their impact on U.S. scientific leadership. Now representative scientific organizations such as the AAAS and the National Academy of Sciences are again beginning to have some influence. For the space program, in particular, this means that the fateful reassessment now underway can be made in partnership with the scientific community.

There already seems to be a certain degree of basic consensus, reflected in the AAAS panel discussion. The expense of the space program is recognized as an investment, according to several panelists, including Dr. Keyworth. Congressman Don Fuqua (D) of Florida put the return at $14 for every $1 invested. Dr. Press, noting that all such estimates are uncertain, envisioned a return to the nation of several hundreds of billions of dollars over the next decade or two. There also seems to be an emerging consensus that the space program should be "balanced," maintaining some vigor in planetary exploration. And, significantly, there appears to be strong emphasis on international cooperation.

Virtually every panelist mentioned the importance of joint projects with Europe and Japan—projects where costs can be shared. Frank Press reminded the panel that members of the European Space Agency feel badly cheated because the U.S. has unilaterally canceled its part of a joint project to send twin spacecraft to observe the sun—the International Solar Polar Mission (ISPM). He noted that Europeans, having committed substantial resources to this project, look upon such an agreement as "an unbreakable treaty." He explained that the U.S. must not let this happen again if it wants fruitful international partnerships. Acknowledging that ISPM has been an embarrassment, Dr. Keyworth said: "I assure you this administration values international cooperation in space, perhaps more than in other areas of science."

Continuing Education

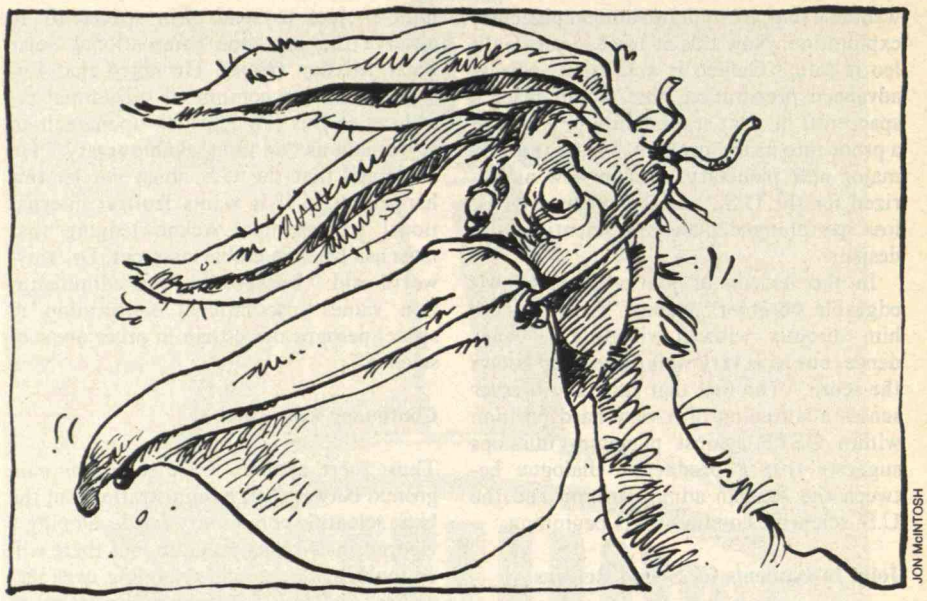
Thus, there appears to be some common ground between the administration and the U.S. scientific community for developing a vigorous new space program, but there will undoubtedly be much wrangling over priorities. OSTP is talking about a program centered on the shuttle, and questions which agencies should have primary responsibility. "Should NASA continue to run a bus company?" asked Dr. Keyworth. Others are concerned that without the shuttle, NASA would be emasculated, with shuttle operations becoming largely the responsibility of the Department of Defense. (*See "Implications of the Space Shuttle: Our Business in Space," by Jerry Grey, October, page 34.*)

The debate will be lively, but at least now it should include strong input from outside NASA, the Office of Management and Budget, and OSTP. The isolation of the administration from the scientific community is beginning to erode. Dr. Keyworth, especially, seems to be gaining a wider view than when he first came to OSTP after spending many years at the Los Alamos weapons laboratory. My newspaper colleague Joseph Harsch, in following the evolution of U.S. foreign policy, likes to talk about "the continuing education of Ronald Reagan" in the realities of international policymaking. Perhaps we are also seeing "the continuing education" of George Keyworth in the realities of U.S. science policymaking. □

Robert C. Cowen is science editor of the Christian Science Monitor *and former president of the National Association of Science Writers.*

Kenneth Boulding

A New Face for the Democratic Party?



A few weeks ago I went down to the county courthouse and, with some trepidation, became a member of the Democratic Party, having recently resigned my Republican membership. I felt this was my duty, in spite of having a highly nonpolitical stomach—as W.S. Gilbert said, "Duty, duty must be done, the rule applies to everyone." My sense of duty arises from the feeling that some alternatives must be found for the present administration and mood of the Republican Party, which seem to be heading toward a variety of cliffs: the mile-high cliff of nuclear war, the 100-foot cliff of a major depression, or the 50-foot cliff of accelerating inflation. The first would be fatal, the second could break a lot of bones, and the third would certainly shake us up unpleasantly.

I confess to being very skeptical about "optimization." There is a wide range of social policies over which it is hard to tell whether we are worse off or better off, which leaves plenty of room for argument. Often the issues are not of crucial importance, but I do worry about the cliffs—the potentially fatal systems. Both in the economic system and the international system, we now seem to be moving into regions where cliffs are more likely, and I am very anxious that we should move back into the more comfortable central plateau in the interest of a reasonable conservatism. Whether the Democratic Party can do this, I am not sure, but at the moment there seems to be no alternative.

A New Suit for Old Ideas

An important question is whether the Democratic Party will have any new ideas. Being a rather conservative party, it has not had many new ideas for at least 50 years. Franklin Roosevelt had a few, mostly borrowed from even older European ideas (from Bismarck and the British Fabians). We might argue that conservatism was a new idea in the 1960s, perhaps reflecting the still moderately uncrowded nature of the American physical environment and resulting in the National Environmental Protection Act and Agency. But even this harks back to the first conservation movement of Governor Pinchot and Teddy Roosevelt in the 1900s.

The Republican Party has come up with the new phrase "supply-side economics," though whether this represents an idea is very arguable. If it is an idea at all, it is that, yes, Virginia, there is an elasticity of supply in the production of particular commodities in response to favorable exchange environments. But this principle cannot be generalized to the economy as a whole, except perhaps in terms of A.C. Pigou's idea at the turn of the century: that alternate epidemics of optimism and pessimism underlie the business cycle. Franklin Roosevelt was a good exponent of this doctrine: he probably did more for the economy by making fireside chats and cheering people up than by any positive legislation that he recommended. If President Reagan had confined himself to cheering people up (as he is an old actor, he is very good at it) without doing anything very much, one wonders if we might be in better shape today.

From my remote and provincial Rocky Mountain fastness, I do not expect to exert much influence in the turbulent political scene. However, perhaps my duty lies in trying to throw out some ideas in the hope that somebody down below might catch them.

The first is that the Democratic Party needs a new symbol, especially since the Republican elephant seems to be turning into a Pegasus—heavy-set, one-winged, flapping about on the ground with considerable loss of dignity. The Democratic donkey is a little too down-to-earth and resistant to new ideas to symbolize what a new Democratic Party might look like. I would like the new symbol to be a bird, partly because we need something to get us off the ground and partly because we need two wings—a right wing and a left wing.

The old debate between right and left has largely disintegrated because the right wing has become radical and the left wing conservative. When right and left is presented as a choice, the answer tends to be "a plague on both your houses." There are important elements of truth in both points of view—each tends to be deficient in something. The left is perhaps too optimistic and the right too pessimistic about human virtue; the right is a little short on compassion, and the left is short on incentives. Both right and left tend to overestimate the value of threats for different purposes. Surely we need a synthesis.

So the question is, what bird? The eagle will not do, as it is a national symbol. It is no doubt unfortunate, and perhaps too realistic, to have an endangered species for a national symbol, but we seem to be stuck with it. (Benjamin Franklin suggested the turkey as an alternative.) As a peacenik from way back, I have slight leanings towards the dove, but I don't really like the dove, even as a symbol of peace. Not only is it a rather stupid bird, but it has absolutely no conflict-management techniques: when doves get after each other they fight to the death, unlike wolves, who ritualize conflict and better symbolize peace.

I finally end up, therefore, with the pelican, and I am reminded of its virtue by an old limerick: *A wonderful bird is the pelican; His beak can hold more than his belican; He can hold in his beak enough food for a week . . .*

The last line escapes me, which is proba-

bly just as well, as it might not be suitable for a magazine such as this. The pelican has both a right wing and a left wing, it flies with a real flap, and its capacity for storing food suggests the virtues of capital accumulation and long-range policies. Furthermore, it is an amusing bird with a sense of humor, something the Democratic Party badly needs.

Slimming the Pelican

The pelican may have so much in its beak that it finds it rather hard to fly, again a symbol for the Democratic Party. The party draws a lot of its nourishment from its long and close association with the labor movement, which tends to do the political donkey work.

I once spent a year studying the American labor movement when I was at what was then Iowa State College at Ames. The American labor movement has always fascinated me by its variety and complexity. It made very important contributions to American life in its early days by promoting universal public education. In later times, it developed a system of industrial jurisprudence and grievance procedure to protect its members against the arbitrary power of supervisors and straw bosses, and it helped to integrate a considerable part of the labor force into the mainstream of American political life. In this country, the labor movement has mostly been a "disalienating" force, much to its credit.

However, after its great expansion during the 1930s and 1940s, the labor movement stagnated. For three decades, it has represented a declining segment of the labor force, now comprising about 18 percent. It has become an extremely conservative force, protecting the economic gains of its members from potential competition from immigrants and the really poor. If it has redistributed income at all—about which there is some question—it has probably been from the poor toward the middle, with very little away from the rich.

There is a myth that what the worker gains in collective bargaining, the employer loses. This is largely nonsense. If the worker gains anything, it is usually at the expense of the purchasers of the ultimate product. The real conflict is clearly between groups of organized labor, often quite small in number, and the rest who purchase their products.

Union-busting has rarely been done in the interest "of the rest of us" but rather in the interest of a quieter life for employers, and we cannot lightly jettison the large positive contributions of the labor movement to American life. Nevertheless, the labor movement itself seems to have had very few new ideas in a long time. It is a stagnant, slightly privileged minority, and its close alliance with the Democratic Party undoubtedly alienates considerable numbers of potential party members and voters. However, the Democratic Party cannot tear itself loose from the labor movement without finding an alternative for grassroots support.

There is evidence that the relatively nonadversarial mode of the labor movement in Japan has something to do with the remarkable development of Japanese productivity. This success may also have something to do with a little-recognized fact that although Japan has always had highly Reaganish attitudes toward the publicgrants sector, which is about the smallest among the rich countries, it distributes a larger proportion of its national income to its bottom 10 or 20 percent than any of other rich country.

Whether the American labor movement could catch a larger vision of itself, I do not know. It has drawn a certain parallel between itself and the solidarity movement in Poland. The solidarity movement must also face the question of whether it can improve the overall economy. A purely adversarial role can easily lead to disaster—nobody can redistribute what is not there.

If today we were writing a political manifesto of hope for the future, what would it look like? Any revitalized Democratic Party must face this question. At the momemt, I think we know only dimly what such a manifesto might say. Perhaps we do not need a document, but we do need hope, without which there is no future. Come on, pelican, get something in your beak that is really nourishing! □

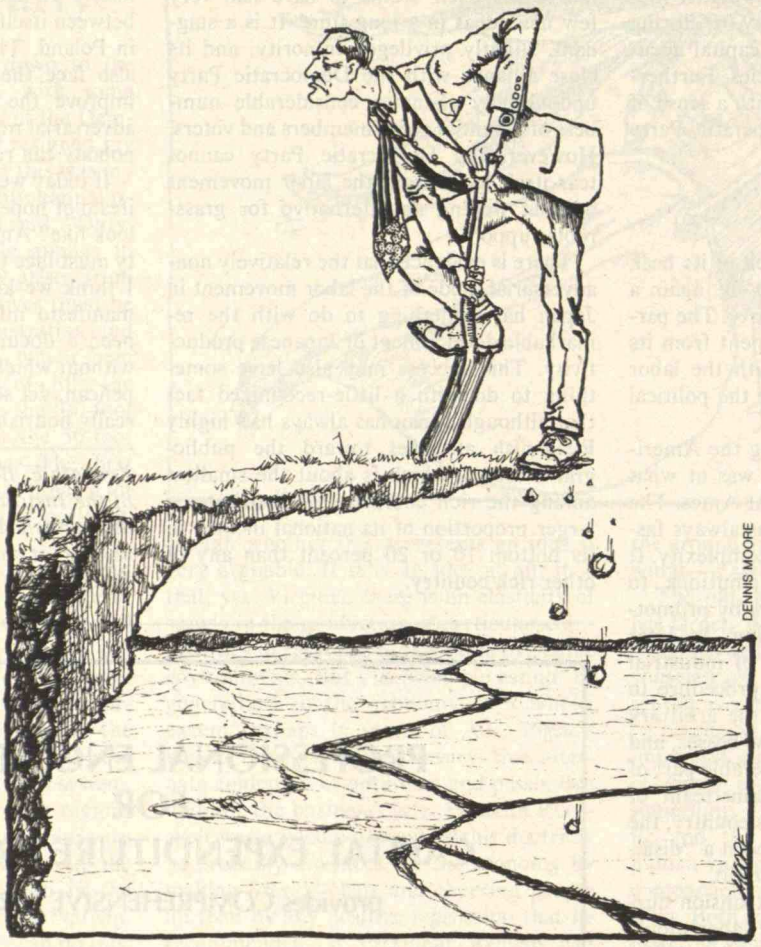
Kenneth F. Boulding is a program director of the Institute of Behavioral Science and distinguished professor emeritus of economics at the University of Colorado at Boulder.

Nearsighted Leaders, Long-Range Challenges

by Russell W. Peterson

No greater problem faces our nation than the government's inability to make accurate projections of global trends in population, resources, and environment, to analyze their social and economic implications, and to integrate this information into federal decision making.

The most significant attempt has been the *Global 2000 Report to the President*, a million-dollar study by 13 federal agencies completed in 1978. But the report itself notes that "the executive agencies of the U.S. government are not now capable of presenting the president with internally consistent projections of world trends for the next two decades." It added that "each agency has an idiosyncratic way of projecting the future based on its own responsibilities and interests. These different approaches were never designed to be used as part of an integrated, self-consistent system."



Much of the attention attracted by *Global 2000* focused on the alarming consequences predicted by the turn of the century if current global trends continued—some people called it a "doomsday report." Yet its real message was that life for most people in the year 2000 would be more precarious "*unless* the nations of the world act decisively to alter current trends." If we look at the report as a vehicle for making us aware of the need to redirect government policies to avert disastrous consequences before it is too late, *Global 2000* can be seen as a document of hope. (*See "The Value of Doomsday Reports," November/December 1980, page 78.*)

Whither the World?

But how can we adequately read the trends and make appropriate decisions if the government has no system dedicated to such a complex assignment? It is puzzling that the United States, with the most sophisticated data-processing systems in the world, a high degree of computer-modeling expertise, and unexcelled policy-analysis capability, has so long resisted establishing even one group for conducting global analysis and planning at the highest level of government, where it is needed most.

This lack is especially strange because it is considered perfectly splendid, indeed necessary, for industry to conduct long-range planning. But for government to do so becomes somehow unsavory—smacking perhaps of communism or, at the least, socialism. Recognizing this unfortunate connotation, we might substitute the term "foresight capability." What we are talking about, of course, is not a planned society, but rather the use of planning by our democratically selected leaders to meet society's needs.

There are many examples of how foresight capability could help steer our national course. One concerns today's serious problem of hazardous wastes. The nation is laced with thousands of hazardous-waste dumps. Through leaching and wind erosion, these are spreading toxic chemicals throughout our ecosystems and poisoning water supplies, farmlands, and building sites. If a government "forecasting agency" had existed several decades ago, it probably would have foreseen—in light of the chemical industry's rapid growth—the need to ensure safe and practical disposal methods for the thousands of new chemicals being created annually. It's likely that the federal forecasters would also have ensured that the users of the new chemicals paid for appropriate disposal, rather than passing such costs on to future generations. Given this kind of sound economic consideration, some hazardous chemicals would certainly have lost out to other materials in the competitive marketplace.

Today, we exhibit similar but more serious negligence, failing to bring foresight to bear on the nuclear-waste problem. Even though we are in the early phases of the nuclear era as projected by its promoters, a frightening array of wastes has already accumulated, including mountains of uranium mill tailings, billions of cubic feet of low-level wastes, deadly high-level wastes temporarily stored in dozens of locations, and abandoned radioactive facilities awaiting the nation's decision to spend almost as much to dispose of them as it did to build them. We obviously need to consider the implications of the accelerated buildup of such wastes over the next decade.

Another argument for the establishment of foresight capability in government is that the rate of change is escalating, leaving us less and less time to alter a threatening trend once it is recognized. For example, many biologists tell us that increasing human activities—propelled by more people trying to improve their standard of living—are alarmingly accelerating the ex-

tinction of other species. To ignore the long-term impact of such trends is foolhardy.

The faster we move, the more important it is that scouts tell us of the problems and opportunities ahead. The military has traditionally used such scouts. Now, when we have threats to our national security every bit as serious as military threats, we sorely need more comprehensive scouting. One such threat is the political instability that often grows out of a nation's limited capacity to meet the demands of its people for food and natural resources. Advance knowledge of how growing population will affect available resources, and how environmental impacts may affect resource supply, may be significant in national security decisions. And importantly, such insight may help in developing the best ways to aid hard-pressed nations.

There have been a number of attempts over the years to establish some foresight capability in government, but most were short-changed and short-lived. Our myopia—when we focus on the present and worry about such things as how many dollars we can make this year or how to get reelected—blinds us to global and longer-term considerations.

To use Herman Kahn's words, we muddle our way into the future. In so doing, human beings—the "ultimate resource" as Julian Simon calls us—have in some ways made great progress. And for many humans progress will continue, unless we muddle our way into a nuclear holocaust or irreversibly befoul or deplete the planet's natural systems. But I believe that many of the hundreds of millions who die prematurely or suffer severely from hunger, disease, and war—and much of the inestimable natural riches that are recklessly squandered—could be saved with a little foresight.

The Risks of Muddling

Fortunately, as the rate of change escalates and the margin of error for avoiding a catastrophic mistake narrows, many individuals are demanding that we think before we act—that we analyze the long-term and global implications of our actions and consider available alternatives.

The nation took an important step in this direction in 1970 with passage of the National Environmental Policy Act. NEPA required federal agencies to prepare environmental impact statements for all major actions. This meant examining alter-

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Reagan's EPA: The New Fuddyduddyism

by Steven J. Marcus

It is fair to say that the Environmental Protection Agency (EPA) and other regulatory agencies may have occasionally been a little overzealous during the past decade. Their regulations sometimes appeared excessive, capricious, expensive, and counterproductive. So with the coming of President Reagan, "regulatory overkill" begat "regulatory relief."

Let us trim the fat, said the new administration, and simplify, decentralize, economize, and optimize. Let us be efficient. Let us unbind the business community from Washington's oppressive authority and liberate free enterprise—the spirit that made this country great. We will work *with* industry, not against it. If the question was "How do we spell relief?" the answer was "nonregulatory."

It did not seem like such a bad idea, providing it didn't go too far. Things might be fine, in fact, as long as the federal agencies didn't cede their responsibilities altogether and the new thrust was the product of people who were sensitive, knowledgable, competent, and committed to protecting those areas Congress mandated them to protect.

Although many an environmentalist expressed horror at the prospect—ten years' work would be undone by Reagan's "wrecking crew," they predicted—some of us were more hopeful, even while watching one unlikely appointee after another march into power. Maybe, we thought (wishfully), these people with business connections might succeed where others had failed. "Market solutions" might indeed be more efficient, fair, and effective than "command and control," and the no-nonsense attitudes of these nonenvironmentalists might, ironically, benefit the environment as never before.

Not with a Bang

But my moment of truth has come. It was at the 1982 meeting of the American Association for the Advancement of Science, while watching John Hernandez (EPA's deputy administrator) deliver an unfocused and uninformative hodge-podge of a speech more suited to a Monty Python satire than to a serious discussion of federal policy. And it was confirmed later that day by Kathleen Bennett, an EPA assistant administrator, who matter-of-factly described the federal noise-pollution-abatement program as "ready to be packaged" for use by the states—even while David Hawkins, its developer and her predecessor, was acknowledging there and then that the abatement program was still immature. After a year of unprosecuted cases, delayed deadlines, uninitiated programs, and large voluntary reductions in budget, personnel, and authority, these performances symptomized for me the demise of EPA: not with a bang but a whimper, not by formal execution but through death by a thousand cuts. I recalled what a distinguished Washington consultant once told me: that the best way to neutralize an operation with high visibility and public appeal, such as EPA, is not to kill it outright—that is politically unwise—but to appoint hostile, uninspired, or incompetent managers and then let nature take its course.

A dearth of federal authority wouldn't be so terrible if the bureaucrats abdicating their responsibilities recycled their data to state agencies. That, in fact, is supposed to be the goal. But the past year's track record indicates the opposite: state environmental officials have been continually frustrated by EPA's foot-dragging, noncooperation, and penchant for secrecy. Limits on travel, publication, and dissemination of data have been imposed with a vengeance.

"There is a distinct change from the previous administration," notes one state water-pollution control official. "I simply don't have the feeling that they're trying to help us solve our problems. For example, I used to have no trouble getting data; they'd give us their numbers freely, if with qualification. But starting last May [coincident with the appointment of Anne Gorsuch as EPA administrator], agency staffers have not been allowed to talk. I've had to spend a great deal of time duplicating information that EPA already had. Is this what they mean by 'power to the states?' "

The old (pre-Reagan) EPA may well have bitten off more than it could chew—"our eyes were bigger than our tummies," says John Quarles, former deputy administrator under President Ford—but at least its heart was in

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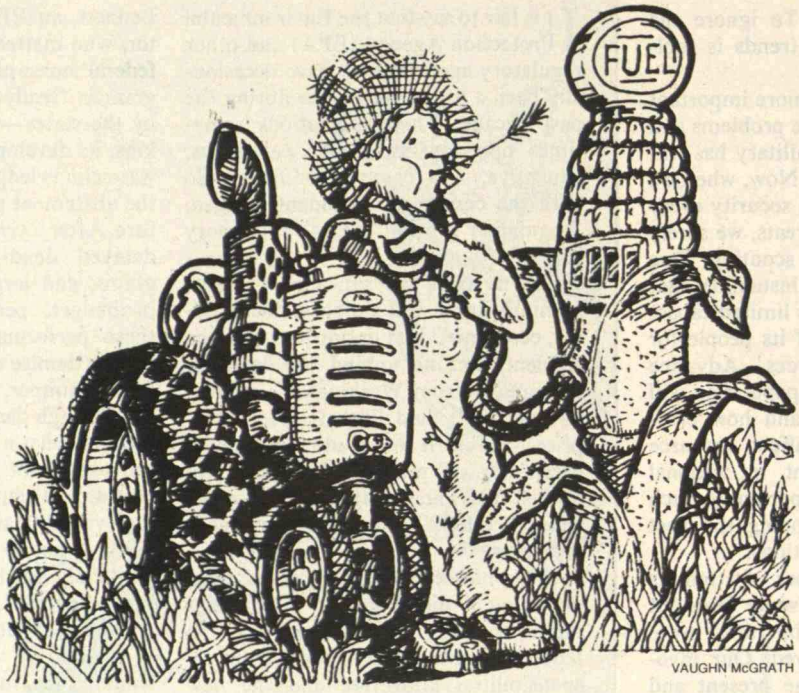
Fueling American Agriculture

by Robert H. Tweedy

To guarantee a steady supply of daily bread, along with all the other foods on the nation's table, American farmers need "fuel insurance." Providing alternative fuels, especially liquid fuels from biomass, is an essential goal if we are to avert a potential world food crisis resulting from a cutoff of foreign petroleum supplies.

Most farm operations must occur on a schedule allowing little margin for error. Nearly all crops have an optimal planting date, and yields can be reduced by as much as 1.5 percent for each day that planting is delayed. And late harvesting leaves mature plants exposed to weather, insects, animals, and molds—reducing both the yield and quality of the crop. From preparing soil to getting their products to market, farmers rely on mobile units powered by gasoline and diesel oil. Thus, it is difficult to overstate the importance of a reliable fuel supply.



VAUGHN McGRATH

But while U.S. farm production—responsible for 70 percent of the food in international trade—depends almost totally on petroleum-based fuels, domestic petroleum supplies are not adequate for our needs. This picture impels agriculture's search for other fuel sources as "protective insurance." Substitute fuels must be compatible with current engines, affordable, and must not disrupt the food supply or significantly raise the prices of food, feed, or fibers.

Growing Interest

As a renewable and abundant energy source, liquid fuels made from biomass—or biological liquid fuels—appear to be an attractive alternative. (The term "biomass" covers all organic matter that grows by the photosynthetic conversion of solar energy, including crops, trees, and various agricultural and forest wastes.) Biological liquid fuels are not new, but never before have they been the subject of such intense international investigation—or of such public expectations of success.

This led the American Society of Agricultural Engineers (ASAE) to form a special task force to assess the prospects of these fuels. The task force included 22 representatives from industry, academe, and government, and its October 1981 report—while encouraging continued research—identified a number of technical and economic problems, involving both production and use, that must be resolved before such fuels can make a significant impact on farms.

The United States has the necessary technological base for on-farm production of biological liquid fuels. It is clearly not possible at this time to produce enough biological fuels to significantly reduce our *national* dependence on petroleum fuels. However, sufficient biological fuels could be produced to serve the needs of farmers themselves—and striving for this on-farm capability is a valid goal.

Reaching that goal will require development of efficient, small-scale processing units, reduction or elimination of possible safety hazards, reduction of production costs, improved processing technology, and better ways to handle and utilize by-products. Eventually, we must also develop a new generation of internal-combustion engines that operate satisfactorily on farm-produced liquid fuels.

The ASAE task force explored two types of biological liquid fuels: alcohols derived from starch or sugar crops, and vegetable oils derived from oilseed crops. However, many other alternative fuels are being actively pursued, including alcohol from cellulose; liquid fuel from coal, shale, and tar sands; and hydrogen produced by electrolyzing water. But these fuels are generally better suited to large-scale industrial production than farm use.

Of the candidates for alcohol fuel, most promising in the near-term is ethanol (commonly called "grain" alcohol). Ethanol can be produced through fermentation and distillation of any one of a number of crop feedstocks. Plants naturally laden with sugar—such as sugar cane and sweet sorghum—can be fermented directly, with yeast used to chemically change the sugar to alcohol. Starchy crops, such as corn or cereal grains, are first "saccharified" by cooking them with special enzymes and then fermented as usual.

The alcohol is then concentrated, the water removed by distillation. Concentration to 160 to 190 proof, or 80 to 95 percent alcohol, is necessary for fuel use. If the alcohol is intended for making gasohol (a blend of roughly 90 percent gasoline and 10 percent alcohol), concentration to 199-plus proof, or 99.5 percent alcohol, is required. Finally, federal law mandates that the alcohol be denatured, or rendered unfit for human consumption.

Fuel By the Ear

Corn is now the most readily available raw material for high-volume on-farm ethanol production. Five acres of corn will yield about 1,000 gallons. This means farmers could be energy self-sufficient for field operations by using the fuel from 1 acre of corn to farm about 20 acres.

Yet corn does not produce the highest ethanol yield per acre. Sugar cane is the leader, requiring only 1.6 acres to yield 1,000 gallons in those warm areas where it it can be grown. And several studies have concluded that the best overall crop for most of the U.S. is sweet sorghum, requiring 2.5 acres for a comparable yield. But corn does have one advantage: only its starchy portion is converted to alcohol, and the balance, which is high in protein, can

be used for human and animal consumption.

If recent patterns of food supply and demand hold, enough corn to produce 2 billion gallons of ethanol could be diverted without seriously threatening world food supplies or raising corn prices. However, production of 4 billion gallons would nearly double the value of corn if corn production remained steady. As a measuring stick, replacing the 3.5 billion gallons of gasoline used by farmers annually (in 1978) would require over half the corn now exported, or about 20 percent of the total crop.

The highest hurdle facing on-farm production of ethanol is cost. It currently runs between $1.20 and $2.18 a gallon (depending on the price of corn) for a huge industrial facility to make ethanol. Farm operations will be more expensive. For example, the task force identified the cost for one large farm processor to be about $2.44 a gallon to make 40,000 gallons of ethanol annually. In another analysis, a smaller farm operation producing 6,000 gallons annually could expect alcohol costs to average $4.58 a gallon. In simplest terms, there is no way at present to produce ethanol in small quantities at a cost that even approaches conventional fuel prices.

One important factor behind the high cost is that large amounts of energy are needed to distill ethanol to high-proof fuel specifications. Developing more energy-efficient methods would shift the energy balance of ethanol production to a definite positive value. At least three alternative alcohol-water separation methods are being tested on laboratory scale, but it remains to be seen whether they are suitable for farm-scale operation.

Treating the high-protein material left after ethanol production also takes a lot of energy. This "stillage" can be 95 percent water, making it difficult to handle and subject to spoilage. Feeding untreated stillage directly to animals is possible but not practical given current handling and storage techniques. Dehydration to eliminate the water is the best known answer, but extremely expensive because of the amount of energy required. The costs can be reduced somewhat by using cheaper forms of energy, such as wood, or waste heat or gas produced by other farm operations, but continued research in this area is needed.

Still another problem is that current distillation methods for producing high-proof alcohol make use of the toxic chemical benzene, a process considered too dangerous for farm use. However, new chemical "absorbers" and molecular "sieves" are being evaluated and may make this distillation step ready for farmers.

Overcoming Engine Problems

When it comes to daily use of alcohol fuels, it is not a question of whether engines will run, but how well and how long they will run. Alcohol/gasoline blends of up to 15 percent ethanol generally perform well in spark-ignition engines, although fuel filters tend to clog and the lives of carburetor seals and fuel system hoses may be shortened. Unlike petroleum-based fuels, ethanol provides very little lubrication; thus, when used in diesel engines, failure of fuel pumps and injection nozzles can increase. Diesel engines have been proven to operate on blends of up to 30 percent alcohol and 70 percent diesel oil if lubricating additives are used and certain engine modifications are made—and based on recent tests, even a 50 percent blend looks possible.

Conventional gasoline and diesel engines do not operate efficiently or dependably on straight alcohol fuel, and improved performance requires extensive engine modification. But until demand for such engines grows considerably, engine manufacturers cannot afford the substantial necessary retooling. Until major new engine designs are available, users of alternate fuels should either make those fuels as much like conventional fuels as possible, be willing to experiment with engine modifications at their own risk, and/or be willing to accept lesser engine performance and durability.

In addition to ethanol, two other alcohols are being considered as motor fuels: methanol ("wood" alcohol) and butanol. The ASAE task force did not investigate these because their current production methods are not readily adaptable to farm use. But with breakthroughs in production technologies, the conversion of cellulose (the structural building blocks of plants) to methanol could be an attractive on-farm alternative. This would mean that the planting of fast-growing trees and other selected crops could be expanded, especially on lands not well suited for grain production. Also, otherwise underutilized cellulosic wastes from forests and farms can serve as feedstocks.

Oilseed Opportunities

Vegetable oil fuels show even more promise than alcohols in many ways. Farm-scale production may prove less capital intensive, and busy farmers could favor the easier "batch process" oil extraction over alcohol distillation, which requires continuous attention.

Perhaps most important, vegetable oil fuels are more compatible with diesel engines and have energy values closer to diesel fuel. The past 30 years have seen a dramatic shift from gasoline to diesel oil for most farm operations, primarily because of dependability, economy, and safety. Nearly all tractors sold today are diesels, and a growing number of farms rely totally on diesel power.

A wide range of oilseed crops can be grown in the United States, including sunflowers, peanuts, soybeans, and safflower. If vegetable oil fuels become more popular, many more exotic crops might be considered, such as rapeseed, okra, or crambe. Currently, vegetable oils are used mainly for human consumption, and the "meal" left after extraction is a good protein supplement in animal feed.

Producing enough vegetable oil fuel to replace the 3.3 billion gallons of diesel fuel burned by farmers annually would require more oilseed crops than now produced solely for food purposes. Obviously, oilseed crops would need to be increased greatly to meet both food and fuel needs. Some of these crops might be grown on marginal lands not suited for other crops, provided proper farming practices are employed to protect the soil. The ASAE report estimates that farmers could be energy self-sufficient by using the fuel from one acre of sunflowers to farm eight acres.

Currently, the oil can be extracted from seeds in two ways: mechanically or chemically. The crude (raw) oil must then be "degummed," removing numerous fatty materials capable of forming sticky deposits in engines. Chemical extraction makes possible recovery of nearly all the oil but presents safety problems because the solvent used is highly flammable.

However, the mechanical "screw-press" extraction method shows promise for farm use. It removes 60 to 80 percent of the oil from sunflower seeds and 96 percent of the oil from soybeans or peanuts. The biggest drawback is that American-made presses are too large for farm use, though smaller machines are manufactured in Great Britain and Japan. Other extraction methods are under study in several laboratories, but farm-scale operation has yet to be demonstrated.

Better utilization of oilseed by-products represents a good opportunity to improve the economics. The protein-rich meal left after extraction has a high fat content and

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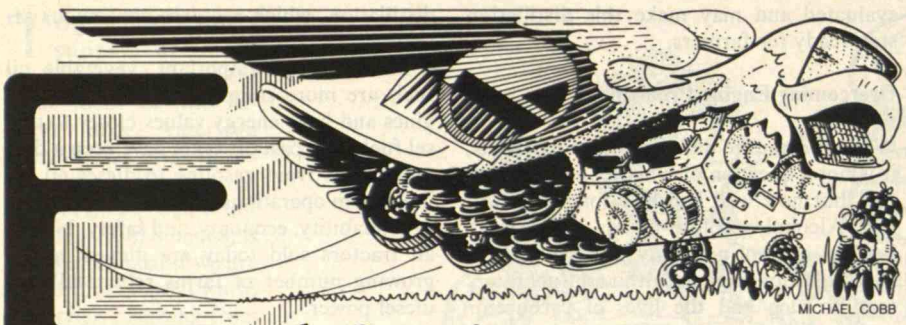
BOOKS & COMMENT



Eagle Scouting

The Soul of a New Machine
Tracy Kidder
Atlantic-Little Brown, 293 pp., $13.95

Reviewed by Ellen Williams

Eagle is a computer that soars from Data General's subterranean labs to the heights of its sales charts. If you think that's the sort of epic ascent that cries out for docudramatization, or immortalization in some equally fashionable genre, you'll be pleased to know that Tracy Kidder has done exactly that. *The Soul of a New Machine*, brimful of technological intrigue, corporate scheming, and pseudoengineering, is the tale of Eagle's transformation from gleam-in-the-eye to top-of-the-line.

Although Kidder is clearly a gifted writer, with a genius for rendering the intricacies of high technology accessible to a lay audience, *Soul* is nevertheless a mixed blessing. The first legitimate behind-the-Silicon-Curtain tour ever offered to the general public is a ten-day, 22-city whirlwind extravaganza.

The book opens with a brief but gratuitous prologue depicting the book's protagonist, Tom West, as a cross between Mary Poppins and the Ancient Mariner. The prologue is followed by an abbreviated history of the computer business and a somewhat lengthier history of Data General. We learn that the minicomputer business, circa 1978, is dominated by Digital Equipment Corp. (DEC), and that Data General, the Avis of the mini business, has nothing that can compete with DEC's recently introduced supermini, VAX.

Enter Eagle, the in-house name for what ultimately became the Eclipse MV/8000 but at the start of the book is merely a vision. As competition for VAX, most of the movers and shakers at Data General think Eagle could be marginally better than nothing; the rest don't think it will be that good. Eventually, the corporate brass makes a heralded nondecision to tolerate Eagle's development.

And so, unceremoniously, we find ourselves adrift midst the bits and branches of computerdom. Kidder guides us with the refreshing authority of a high-technology Huck Finn as we bobble along in Eagle's wake. He educates the unsophisticated reader painlessly, sliding in nuggets of technical knowledge along with regular doses of gory coporate politics. Unsurprisingly, the educational component of the narrative obeys the law of Conservation of Enlightenment: clarity for the neophyte engenders obfuscation for the knowledgeable.

As it is, the explanations of the subtle complexities of designing and debugging a computer are the finest passages in the book. Such esoterica as how to design an upward-compatible computer without a mode bit and how to build a ring number in a 32-bit address are explained. We share the romance and the suspense of engineering development while two prototypes are built, tested, and bludgeoned into working order. The last few chapters include the conversion of the prototypes into assembly-line products, some miscellaneous philosophizing, a where-are-they-now epilogue, and, unorthodoxly, the acknowledgments.

Given its extraordinary range, the book is a triumph of craftsmanship. The only serious blemish on the veneer of Kidder's crisp, clear prose is the anticlimactic and amateurish philosophizing: "Since [Norbert] Weiner [sic], practically every kind of commentator on modern society, from cartoonists to academic sociologists, has taken a crack at the sociology of computers. A general feeling has held throughout: that these machines constitute something special, set apart from all the others that have come before. Maybe it has been a kind of chronocentrism, a conviction that the new machines of your own age must rank as the most stupendous or the scariest ever; but whatever the source, computers have acquired great mystique."

Do tell.

A less superficial disappointment is Kidder's inability to bring the people who build these machines to life. Although his depictions of the characters are rich with detail—their jargon, their hobbies, their lifestyles, their homes, even their driving habits—the sum of all the meticulously reported tidbits does not yield whole characters. Kidder is aware that computer people, like fighter pilots and race-car drivers, are a breed apart, and his astute observations lend authenticity to the anecdotes. But while, for example, he captures such choice bits of jargon as "kludge" and "West went into forest-fire mode," he doesn't point out that you can spot computerniks less than three sentences into a conversation by their deep-seated need to conduct even the most casual conversation in computerese. Thus, the careful descriptions remain fragmented and lifeless and the anecdotes unrevealing.

The deluge of specifics also tends to obscure the larger aims of the book, so much so that reflective readers, regardless of their technological sophistication, may find Kidder's razzle-dazzle description of the computer industry a bit like the six blind men's description of the elephant. The importance of anything relative to anything else—the importance of Eagle to Data General, the importance of Data General to the computer industry, and the importance of the computer industry to civilized society—is difficult to grasp.

Kidder tries to cover a lot of ground—too much, one suspects, for a single volume. He has tossed in something for everyone, from the minutiae of computer engineering and corporate management to cybernetics and sociology. But to what end? His intent is difficult to divine. Is this book about Data General, or Eagle, or the people who built Eagle, or the research and development process generally? About technical design, corporate management, or cutthroat competition? Kidder never says.

Nor does he ever tell us how he came to write this book. Why, for example, did he choose Eagle, rather than some other computer, or even the grander computer that Data General was developing concurrently? This may not be a pivotal point, but I found myself wondering whether Eagle was, in some respect, an ideal project for Kidder's unstated purposes, or whether the choice was dictated by some mundane but unstated practicality.

A related and more significant question

is who approached whom about this project: did Data General approach Kidder, or vice versa? And what was the quid pro quo of the arrangement? These points assume importance because Kidder raises, and leaves unresolved, a number of moral and ethical concerns about Data General's practices. In the early parts of the book, Kidder dwells on the guerilla-warfare tactics employed against arch-rival DEC, and on the "entrapment" of inexperienced engineers in cannibalistic working conditions. Such practices are hardly limited to Data General, or, for that matter, the computer industry, but Kidder gives us no perspective. Instead, he abandons the issues he has raised, thereby implying that they are not really important after all. Judge Data General by its products alone, he seems to say—the end justifies the means. And with that stroke, Data General is transformed from robber baron into Robin Hood.

Is the transformation credible? Or should it be discounted because, in exchange for access to Data General's hallowed basement, the touchy topics are off limits? Kidder, by not revealing the biases that have shaped his material, has sacrificed some credibility. He prefers to say, in effect: Here is what I have presented; accept the facts at face value and draw your own inferences. Such abdication of interpretive responsibility may leave some readers merely curious and others downright skeptical.

But if the destination is vague, the journey is scenic. This is a book to be savored by appreciators of well-honed narrative; every reader is likely to learn something from it, although perhaps not precisely what he or she had anticipated. Kidder has taken a daunting subject, one that most people expect to be as dry as dust, and handled it with a panache that Alfred Hitchcock would have envied. □

Ellen Williams is former Associate Commissioner for Policy Coordination at the Food and Drug Administration. She has been a computer professional since 1963.

Mind over Matter

The Enchanted Loom: Mind in the Universe
Robert Jastrow
Simon and Schuster, 1981, 183 pp., $13.95

Reviewed by Eric Maloney

Ten years ago in *Man and the Computer*, mathematician John G. Kemeny proposed that we start to think of the computer as a new and distinctive form of life. Challenging the traditional criteria that distinguish the living from the inanimate—metabolism, locomotion, reproductive ability, individuality—Kemeny presented an interesting argument that computers are "sufficiently like species of living beings to justify considering a possible symbiotic relationship between man and the computer."

Man and the Computer is characterized by its humanism. Throughout, Kemeny refers to the computer as a tool, a partner in an interaction that must be combined with "sufficient concern by men for their fellow men and for future generations." The computer, he argues, will be used to improve the quality of human life.

In *The Enchanted Loom*, on the other hand, Robert Jastrow describes the computer as comprising the next rung of the evolutionary ladder. He perceives the computer not as a tool but as "an emergent form of life, competitive with man." He heralds "a new era of silicon-based life—indestructible, immortal, infinitely expandable." His conclusion is that "man is doomed to a subordinate status on his own planet."

To sell his house of chips, Jastrow spends nearly three-quarters of the book tracing the evolution of the brain from the pea-sized lump of the first fish 450 million years ago to modern humans' highly sophisticated network of neurons and axons. The computer, he reasons, will simply be a bigger and better brain, as soon as technology finds a way to etch the human brain's intricate circuitry in sand.

Jastrow agrees that man and machine will develop a symbiotic relationship in which each will become dependent upon the other for survival. The computer, Jastrow says, "Will become man's salvation in a world of crushing complexity." But this mutual mothering won't last for long, for "in the struggle for survival, bigger brains are better." The computer will quickly outdistance its less intelligent creator, and the human brain will never catch up.

How can humans maintain their footing on the silicon slide? By literally joining their minds with that of the computer. Someday, Jastrow predicts, scientists will figure out how to transfer the contents of the human mind into the computer's memory. The brain, he says, "will be liberated from the weaknesses of mortal flesh." Arising will be a new form of existence, one that Jastrow claims "must be the mature form of intelligent life in the Universe."

Jastrow seems to welcome the prospect. When he discusses the "true silicon brain," when he explains how a computer can supposedly be programmed for emotion, when he describes silicon-based life as "immortal," when he describes the symbiosis of humans and machine as an "unbeatable combination of brute reasoning power and human intuition," it is like reading the script to "Dr. Frankenstein Meets the Integrated Circuit."

Jastrow dismisses the standard arguments against the notion that the computer is a life form with a wave of his hand: "I believe that in a larger cosmic perspective, going beyond the earth and its biological creatures, the true attributes of intelligent life will be seen to be those that are shared by man and the computer—a response to stimuli, absorption of information about the world, and flexible behavior under changing conditions. The brain that possesses these attributes may be made of water and carbon-chain molecules and housed in a fragile shell of bone, as our brain is; or it may be made of metallic silicon and housed in plastic; but if it reacts to the world around it, and grows through experience, it is alive."

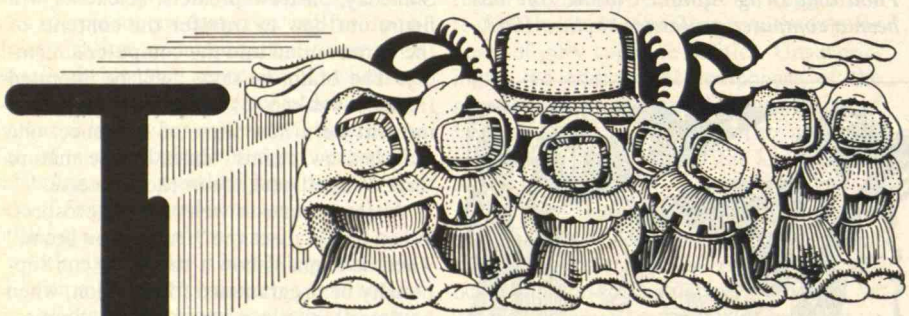
Although Jastrow discusses the mental, physical, and emotional criteria for defin-

ing intelligent, conscious life, significantly, he avoids addressing the spiritual questions. And it is in the realms of spirit and metaphysics that the most complex issues lie. Can a computer have a conscience? Can it develop a value system on which to base its decisions? Can it be programmed to search for moral truths? Can it know the simple pleasures of sharing life's experiences with others? Can it know what it is like to face one's mortality? While these questions point to the intangible forces in our lives, it is just these forces that define us as human beings, that motivate us to explore the nature of human existence, of the world around us, of our gods.

Jastrow's failure to position his discussion within a framework of humanism is distressing. Modern technology has seriously disrupted our sense of well-being. The tools that gave us our skills and identified us as creative and productive members of society have been systematically replaced by great machines of metal and electricity. It's everything we can do to maintain our dignity and worth. At this stage, do we really need Jastrow to reinforce our fears and anxieties?

Kemeny argued that the outcome of the human-computer relationship is entirely up to humanity: "If human beings collectively have enough understanding and enough foresight, they can assure that the interaction between the two species will be totally beneficial to mankind." If only Jastrow offered some insight into how we might achieve this understanding and foresight. □

Eric Maloney is an editor of Microcomputing *magazine.*



The Silicon Giant Unveiled

The Computer Establishment
Katherine Davis Fishman
Harper & Row, 1981, 468 pp., $20.95

Reviewed by Ronald Rosenberg

The march of books, doctoral dissertations, legal tracts, and possibly television specials culled from the parade of witnesses and subpoenaed papers at the International Business Machine Corp. (IBM) antitrust trial has just begun. There are plenty of depositions, memos, documents, and other evidence from the recently closed case to keep many business scholars from seeing daylight until the end of the decade.

Some of the more than 1,000 pages of trial transcript and nearly 12,000 documents contain a curious melange of intellectual gossip. It makes reading about the decisions of past and current IBM executives a form of wicked pleasure, for they can no longer hide behind press releases and batallions of public-relations representatives. For example, when IBM publicly shrugged off claims that its higher computer equipment prices would drive customers away, then-chairman Thomas J. Watson, Jr. was privately worried. One memo reads:

"We ask our sales force to appear with machines that are always higher (priced) than our competitors' and this doesn't help their morale. And so I think we must conclude that as our competitors drop their prices we have a clear choice. We can either follow them, or we can maintain our very high margins, have a balance sheet that looks unusually good for two, three, or even four years and then reap what we have sown in the form of substantially less markets, lowered prestige, and even greater frustration."

Watson's comments are among many in Katherine Davis Fishman's breezily written examination of IBM, its competitors (known fondly as the seven dwarfs), and the entrepreneurial newcomers such as Digital Equipment Corp. By studying internal IBM papers and conducting interviews with an assortment of IBMers over the past 10 years, she has come up with a series of portraits of the people who shaped the computer establishment.

Mike Joyce, for example, was responsible for marketing the System 3 computer, acknowledged as IBM's first "small" computer and designed to fill a key gap at the low end of IBM's product line. "My whole life became making the System 3 happen, and other parts of me died," he recalls. "Toward the end I began to realize that I wasn't having fun anymore, that I didn't want to do this forever."

Today he is a minister at the church of Universal Masters in Dutch Flats, Calif.

While employment at IBM may have left some battered and defeated, there were many others who rose like cream in the competitive atmosphere. In the early days under Thomas Watson, Sr., salespeople sang fight songs ("Ever Onward IBM"). Attracted by security (IBM rarely fired anyone), they were nonetheless driven by fear of professional stagnation. "A salesman," explained former chairman Thomas Vincent Learson, "will write and cry and exaggerate, he'll be gentle with the facts—that's life."

IBM got into the computer business 30 years ago. In 1952, General Electric was eight times larger than IBM and RCA was twice as big. By the mid-1950s, GE had the lead in computers but later blew it, losing $160 million between 1957 and 1970. However, during that time it developed the concept known as time-sharing, which allows many programmers to use the large computer's resources simultaneously, a stroke of ingenuity that no doubt left IBM quite nervous. Nonetheless, GE's lack of a definitive strategy led it to bail out of the computer business.

RCA entered the computer field later than GE and went on to become a casebook example of how to fail in data processing. Bad management, "me-too" technology, poor product and marketing planning, and the 1970 recession did the company's computer operation in. "We were," says one former RCA computer man, "like a child who is given plenty of spending money but no wisdom or understanding."

RCA closed its gleaming new Marlboro, Mass. showcase computer headquarters barely 10 years ago (now a Digital Equipment Corp. division headquarters). Sperry Univac picked up the RCA remains, just as Honeywell scooped up GE's product line.

GE, RCA, Honeywell, and Sperry were

four of the seven dwarfs, the others being Burroughs Corp., NCR, and Control Data Corp. Five of these remain in IBM's shadow, often competing more against one another than IBM. Each has carved out specializations by industry and application. But Fishman says it is difficult to predict how the dwarfs will fare in the future.

What distinguished IBM from everyone else was its commitment to computers. Except for Control Data, the dwarfs considered data-processing equipment just one part of their total business. However, IBM's ascent was not without peril. The company's 360 computer series ($5 billion spent in four years) was troubled by software glitches. In the late 1960s and early 1970s, executives were leaving to become entrepreneurs. And there were a slew of courtroom battles with competitors as well as government.

Fishman points out that IBM was able to triumph in the end "because individuals were bright, competent, dedicated, and hardworking, and partly because IBM had more money." How IBM managed its finances so astutely and calculated that it could beat everyone's cost by manufacturing virtually everything internally is not explored. The book is short on explaining where the other members of the computer establishment are heading. The author directs little attention to Digital Equipment Corp., for instance, already acknowledged by some IBM senior executives as their biggest competitor. There is no mention of how Digital's success might change the makeup and character of the industry.

Robert Sobel, who wrote *IBM: Colossus in Transition*, claims Tom Watson's greatest breach of business judgment may have been not getting into the minicomputer business in the late 1960s. However, IBM hopes to rectify that oversight by diving headlong into the personal computer business this year with a model they say will set a new standard for the industry. Fishman all but ignores this, as well as the enormous impact of mini- and microcomputers on the entire computer world.

The major strength of Fishman's book is the broad canvas it presents to readers unfamiliar with computers. However, the colors come mainly from portraits of IBM executives and alumni and information gleaned from the IBM trial. As a consequence, the book is rather narrow in scope and perspective. □

Ronald Rosenberg is a business reporter for the Boston Globe *specializing in computers and electronics.*

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Fifth in a Series

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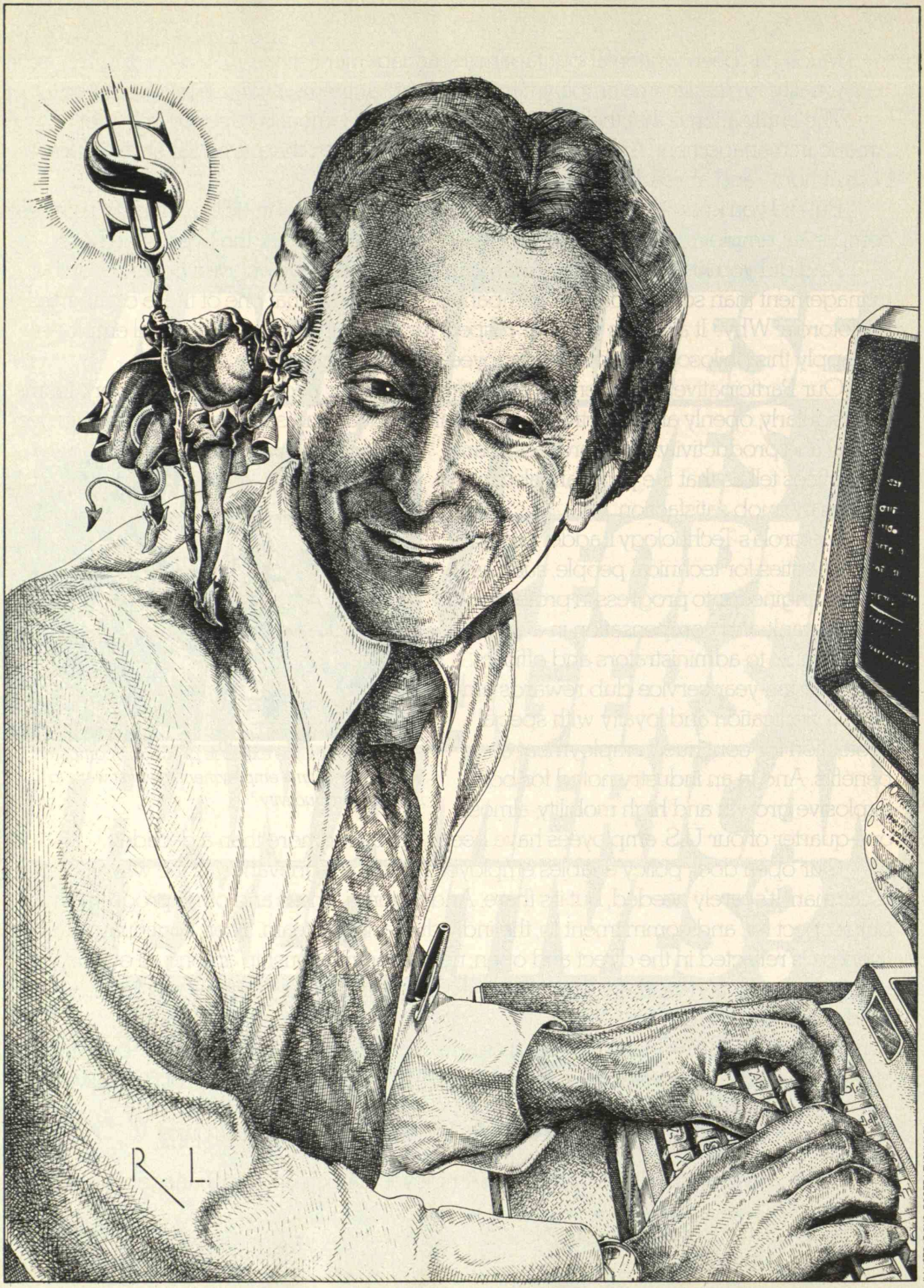


ILLUSTRATIONS: ROGER LEYONMARK

Computer Crime

by Leslie D. Ball

If Willie Sutton were alive today, he would hit computers in large banks because "that's where the money is." But banks are not the only victims of computer crime.

VIRTUALLY every company or organization, no matter how small, is a potential victim of computer crime. The explosive growth of computers, together with the escalating value of the data handled and stored, prompts many authorities to predict that criminal computer capers will, if unchecked, increase significantly in the years ahead.

Actual losses from computer crime are difficult to estimate. Donn Parker, a senior systems consultant for SRI International and an authority on computer fraud, calculates that losses may be $5 billion per year. However, other estimates set losses at only $300 million. Even this lower figure is more than 20 times the annual take of just a decade ago.

Complicating matters, many experts believe that only 10 percent of computer crimes are made public and numerous crimes probably go undetected. What is clear, however, is that many computer crimes involve large sums of money—Parker estimates the average computer bank fraud at $500,000, while conventional bank robbers average only $2,500. For example, in 1980 the Wells Fargo National Bank in San Francisco lost $21.3 million in what reportedly is the largest bank embezzlement in the nation's history. This computer-aided scheme, involving a former bank officer and several boxing promoters, caused losses totaling more than half of all U.S. bank robberies that year. (Although the cases I will cite are well documented, industry has questioned the exact role of the computer in many "computer" crimes. *See page 24.*)

It's in the Bank

Banks often figure in computer crimes because of the increasing use of electronic funds transfer systems, which move huge sums of money among banks with electronic symbols as the only record. This system replaces the personal signatures that once accompanied every banking transaction with electronic authorization codes, a series of unique digits identifying any bank official who can authorize money transfers. Large numbers of financial transactions can be made quickly and at less expense using such a system, but trouble brews if the codes fall into the wrong hands.

For example, in 1979 Stanley Mark Rifkin, a computer consultant and former college professor, stole $10.2 million from the Security Pacific National Bank. After learning the computer's access codes during a visit to the bank's wire transfer room, he simply telephoned the bank, and, posing as a branch manager, used the codes to transfer money to a New York bank—always transferring amounts less than $1 million, since such "small" transactions are subject to fewer internal bank controls. Next he instructed the New York bank to transfer his funds to a Swiss bank. He then went to Switzerland, bought diamonds, and returned to the United States. Only after boasting of the feat was he caught, and while awaiting trial he attempted a $50-million transaction from another bank. When apprehended, Rifkin told a reporter that he thought he finally had all the bugs worked out.

Banks are robbed in other ways, too. The American Institute of Certified Public Accountants (AICPA) has conducted one of the few scientific studies of the characteristics of computer crime. Of 85 bank cases studied to date, 13 involved fictitious loans, 8 involved unauthorized lines of credit, and the rest involved various forms of transaction manipulation. Most of these crimes have not been of the spectacular variety, with 70 percent yielding less than $25,000.

Computer criminals also favor insurance companies. In fact, one of the largest computer crimes so far discovered—totaling over $27 million, though actual losses may never be known—is the Equity Funding fraud. From 1965 to 1971, the company used its com-

Many otherwise trustworthy employees have committed crimes after accidentally uncovering flaws in the computer system.

puter to write thousands of phony insurance policies, and then sold those policies to companies called reinsurers. According to the AICPA study, other kinds of insurance computer crime include fictitious claims, fraudulent loans against customer policies, and the switching of addresses and canceling of policies to gain premium refunds.

Computers Get the Goods

After theft of cash or assets, the next most common computer crime is stealing goods, since inventory items are often easily converted to cash. Falsified computer records can make it seem that goods were damaged and disposed of, shipped to a customer but returned, or simply missing.

The Jerry Schneider case is a perfect example. He was an 18-year-old college student when he started stealing from Pacific Telephone, convincing the company's computer that the thefts were actually internal transactions. Posing as a magazine reporter doing a story about Pacific Bell's parts-distribution system, Schneider learned that requests for parts come in via touch-tone telephones and that parts are delivered to any specified location. Now he was in business, entering daily orders and picking them up at various spots. He then sold the products through his company, Creative Telephone. However, an employee soon caught on, asked for a cut but was refused, and turned his boss in—but not before more than $1 million in phone equipment was stolen.

The wealth of information stored in computers, which often has considerable value to business competitors, is another tempting target. For instance, a large computer manufacturer used a computer system to store records of machines ordered but not yet shipped. Unfortunately, an employee with access to the computer system sold the information to another manufacturer. Thus, the competitor could approach a buyer and offer a similar system at lower cost and with an earlier delivery.

Information theft is destined to grow more troublesome as word processors replace typewriters in many offices. These systems are really small computers and are often connected to a company's central computer. Easy to operate, their potential for misuse is staggering. Typewriters do not store information when a report is finished—but with word processors data stay in the system for future recall.

Another common computer crime involves changing the information stored, often to induce a company to make decisions different from those it would ordinarily make. Such a crime occurred recently at a New York college that was automating its grade-reporting system. Students were hired for the monumental task—which required that earlier grades be keypunched onto computer cards—and some began a land-office business in making a "C" a "B" or even an "A." Someone should have remembered that foxes shouldn't guard chicken coops.

Theft of computer time is also a perplexing problem. Although employees are often urged to use the computer, their use can become improper or execessive. For example, at most colleges computer time is thought of as a free good. Students and faculty often computerize mailing lists for their churches or fraternal organizations, which might be written off as good public relations. But use of the computer for private consulting projects without payment to the university is clearly improper.

The picture is similar in business—management often looks the other way when employees play computer games or generate Snoopy calendars. But if this becomes excessive, the employee is "stealing" work time. And computers can process only so many jobs at once: analysis of biorhythm charts and Uncle Harry's taxes could delay the company's payroll. Although considered less severe than other computer crimes, such activities can represent a major business loss. If a technical employee spends half an hour each day on the computer—which is not unusual—the cost in computer time is over $3,000 per year, not including delays in normal processing operations.

Other events sometimes classified as computer crime include theft of programs (software is one of the fastest-growing segments of the industry), theft of computer components or even small terminals, and the destruction of an organization's computer system. For example, a University of Minnesota study indicates that after only 4.8 days without computers, most companies cannot function properly. Computer destruction is generally due to an accidental event such as a fire or storm, but deliberate destruction has occurred.

Who Commits Computer Crimes?

It is tempting to liken computer criminals to other criminals, ascribing characteristics somehow different from "normal" individuals, but that is not the case. Donn Parker of SRI believes the computer criminal "often marches to the same drum as the potential

Information theft is destined to grow more troublesome as word processors replace typewriters in many offices.

victim but follows an unanticipated path." Many otherwise trustworthy employees have committed crimes after accidentally uncovering flaws in the computer system or gaps in the controls monitoring their activities. If the payoff appears high enough, formerly honest individuals could easily succumb to such temptations.

By analyzing computer crime reports and interviewing those involved, Parker has compiled an interesting profile of the computer criminal. Such criminals tend to be relatively honest and in a position of trust; few would do anything to harm another human, and most do not consider their crime to be truly dishonest. Most are male; women have tended to be accomplices, though of late they are becoming more aggressive. Between the ages of 18 and 30, they are usually bright, eager, highly motivated, adventuresome, and willing to accept technical challenges. Actually, they sound like the type of person managers would most like to employ.

Their positions range from data-entry clerk to company president. While direct access to a computer terminal is helpful, they need only a job allowing them to generate data entered into the computer. And perhaps ironically, most computer criminals who have been caught have had no formal computer training; only a modest amount of knowledge seems necessary. They commit frauds in the areas they best understand: payroll clerks steal from payrolls, not from accounts receivable.

How Do They Steal?

Asking how many ways a computer can be burgled is much like asking how many angels can dance on the head of a pin—just as you think you have heard them all, a new method appears. But criminals use certain methods repeatedly, though with many variations. Most common is taking advantage of a lack of control on certain types of transactions. For example, dormant bank accounts receive less attention than active accounts, being checked less often by auditors. A branch manager at New York's Union Dime Savings Bank—who was also a compulsive gambler—knew this and used the computer to "borrow" from such accounts to pay gambling debts. In industry, if a data-entry clerk learns that computerized inventory counts are never verified, the clerk could easily enter a lower figure and then take the items from inventory.

A similar gambit is to take advantage of an error in a computer program. A "bug" can remain undetected for years, particularly if located in a set of rarely used instructions, and often is found only by chance. For example, a benefits clerk entering incorrect data on a specific type of medical claim might uncover a program mistake. Although the clerk finds the error, the computer may not—and the clerk faces strong temptation to use the bug to file fraudulent claims.

Deliberate changes in a computer program can lead to a variety of misdeeds. Sums that are difficult to monitor or unlikely to be questioned are easiest to manipulate. Checking-account fees are in this category. A bank employee could prepare a program that overcharges randomly selected accounts by a small amount (less than the cost of a postage stamp, for instance, to avoid customer complaints), netting a tidy sum for deposit in the employee's own account. Or in an actual case, a company employee writing a program to generate annual W-2 statements included instructions to deduct $4 from everyone's federal taxes. He added the total to his own withheld tax, printed his W-2 with the incorrect amount, and received a massive refund from Uncle Sam. However, a janitor complained to the payroll department that his W-2 was wrong, and the scheme was unraveled. The programmer's error was in thinking that no one would notice such a small error.

Programs can be processed more than once to cover up schemes. Frequently, a miscreant will write two programs for a given task, one correct and one fraudulent. After the fraudulent program has generated purchase orders, checks, or other financial instruments easily converted to cash, the correct program is processed to cover up evidence of the additional transactions.

Many of these frauds can be accomplished by manipulating the computer's "operating system"—basically a program controlling all the other programs processed by the system. Programmers who work with operating systems are called "systems programmers" and are assigned a master account number, much like a building superintendent with a key that opens everyone's apartment. If someone can gain control of a computer's operating system by obtaining a master account number, he or she can copy or change data, change programs as they are running and restore them after completion, or restrict access to various users. In the fall of 1980, for example, two teenagers programmed a home computer to randomly generate master account codes for De Paul University's computer. They reached the university computer by telephone, using a device called a "modem" that trans-

Guilty, Not Guilty, or Not So Guilty?

by Vico E. Henriques

NEARLY anyone who fancies detective stories and has had even a fleeting involvement with computers can recount such legendary "computer crimes" as the Wells Fargo, Security Pacific, and Equity Funding cases. Computer-related crime has become a hot item in the news media. This is not surprising, given its many elements of a good yarn: fraud, theft, vandalism, sabotage, and stealth set against a "high-tech" backdrop. The apparent outwitting of computers—sophisticated machines blamed for uncounted billing mistakes and other snafus that usually end up being human error—is titillating.

There also has been a recent spate of computer-crime doomsday stories involving nuclear accidents or war, international incidents, potential collapse of financial markets and institutions, and terrorist attacks. Scary stuff worthy of serious attention.

But there is one thing wrong with the unexamined regurgitation of all this crime and apocalypse: we at the Computer and Business Equipment Manufacturers Association (CBEMA) think most of it is highly speculative, sensationalized, or erroneous. Thus, the myth of computer-related crime and abuse has become so distorted and exaggerated that the real problems are not being properly addressed.

What Is It?

No one—including the FBI, the academic community, computer users and manufacturers, and the growing colony of computer-security consultants—has accurate data on computer-related crime. What's more, hardly any two experts on the subject can agree on its definition.

For example, a noted attorney writing in the *New York Times* defined computer-related crime as "a criminal act that has been committed using a computer as the principal tool. It can include theft of money, which might result from entry of fictitious payees into an accounts-payable or payroll system, unauthorized use, such as the use of a computer system by employees running their own service bureau, or just plain sabotage or mischief for the fun of it." Not a bad description.

However, the attorney then used the multi-million-dollar Equity Funding insurance scandal to illustrate the danger of computer-related crime, contradicting his own definition since Equity Funding was not, at heart, a "computer" fraud. The electronic data-processing system was not essential to that crime, since less than 20 percent of the fictitious assets of the corporation were ever in machine record form. The computer was used simply to print out the forms essential to the scam; the job could have been accomplished by other, albeit less efficient, means.

In other cases, Wells Fargo officials contend that their alleged losses to a boxing promoter and his ally did not constitute a computer-related crime, and many experts feel that the Security Pacific swindle several years ago does not fit the definition of computer-related crime. In both cases, a serious breach of physical security and poor auditing procedures were involved.

But what about the number of crimes that are computer-related? Aren't they growing if for no other reason than that the number of installed computers is increasing rapidly, especially with the advent of low-cost personal computers? CBEMA does not think so.

One thing that has led to such a distorted view of the "growth" of computer-related crime is the "tip of the iceberg" myth that at least 85 percent and perhaps 90 percent of such crimes go unreported for a variety of reasons. Those figures would be laughable if they were not being accepted as gospel by the media, not to mention the FBI, which is the first to admit its data are woefully lacking. This statistic was derived from a 1976 study indicating that 85 percent of violent crimes in Detroit were unreported. By some leap of logic, the report assumed that 85 percent of computer-abuse cases also must go unreported.

The fact is, according to Peter Watkins, a senior consultant for Peat, Marwick and Partners, that computer abuse occurs in approximately .02 percent of computer installations, or two cases in every 10,000 installations. Mr. Watkins arrives at this incidence rate by dividing what he considers the number of verifiable computer-abuse cases reported annually (75) into the approximate number of computer systems operating (350,000). This is equal to just 1.6 percent of all robberies of U.S. financial institutions in 1978.

He also convincingly challenges annual loss estimates—which range from $300 million to billions—noting that these figures are based on unverifiable cases, including all manner of abuse such as physical destruction, unauthorized use of services, phony computer schools, and so forth. And these figures reflect such notorious but questionable computer-related crime cases as Equity Funding and Wells

Fargo, where losses are in the millions. From 1959 to 1979, a worldwide average of $6.96 million was lost from all industries annually owing to financial deception with computers, according to Peat, Marwick. But CBEMA does not endorse even these statistics, though they certainly represent a far more scientific approach to measuring computer-related crime than any other now being cited.

Crime under Control

Computer manufacturers do not think that computer-related crime is simply a tempest in a teapot trumped up by the news media, liberally aided by consultants anxious to land computer-security contracts. We recognize and are working actively to prevent computer abuse; it is in the industry's self-interest to do so. At the same time, however, we attempt to put the problem in perspective so it can be rationally addressed.

Errors and ommissions constitute the largest single problem for those concerned with computer security. Very few crimes are committed by data-processing professionals—a combination of economic, technical, and procedural controls make it relatively easy to protect data-processing systems against attack by such professionals. The people who commit crimes by using computers are usually clerks, administrators, and operational people who misuse the resources extended to them to get their jobs done.

Thus, while computer crime is not significantly increasing, it *is* democratizing white-collar crime. This problem could be solved if organizations will hold users of computer systems accountable for their actions, limit users to only the actions needed to perform their assigned work, and keep a record of each transaction.

In short, it is relatively easy to make data-processing systems far safer than manual systems. The three major tools for dealing with information-system security are access control, integrity, and encryption. Major manufacturers can build into the systems safeguards against many security breaches, and they can teach users how to prevent most others. Yet there is no such thing as total security. One cannot protect against every eventuality, nor would it be cost-effective to try.

Therefore, it is important that computer users have adequate legal recourse when their files are criminally violated, and CBEMA has consistently supported state and federal legislation that intelligently addresses prevention of computer-related crime. We were early supporters of the overall intent of the Federal Computer Systems Protection Act (S. 1766) introduced by Senator Abraham Ribicoff. And our Privacy and Security Committee has held discussions with Representative Bill Nelson's staff concerning his recent proposal in the House.

As long as computers are used by humans, there will be abuses and there will be crime. Such occurrences can and are being held to a minimum. Computer crime is not now, never has been, and never will be out of control—unless security is completely ignored. And that is not going to happen. □

Vico E. Henriques is president of the Computer and Business Equipment Manufacturers Association in Washington, D.C.

lates digital signals into analog signals suited for the phone lines. It does the reverse when the signal is returned from the computer. They succeeded after several thousand attempts (taking only a few seconds), and prevented the university from using the system for a week by changing all the master codes.

Computers can also be used as speedy "tools" to facilitate illegal or questionable activities. Several students from the California Institute of Technology wrote a program that churned out 1.2 million entries for a MacDonald's restaurant contest. Having nearly a third of the entries, they won the major prizes and many smaller prizes. What made this possible was the students' free and unlimited access to Caltech's computer and MacDonald's policy allowing entries to be printed on plain paper. So the students' actual crime was theft of valuable computer time, although MacDonald's officials did not quite see it that way.

Another famous case depending on the speed of computers occurred at a Florida greyhound racetrack. To win a so-called "trifecta," bettors must pick the exact order of the top three dogs. There are few winners, and the payoffs run to several thousand dollars. The number of possible winning combinations is enormous, so the odds are not calculated until after all bets have been placed—and then only the winning payoff is made public.

In the fraud, a computer operater began the computer calculations as usual at the start of the race. However, after the race he fraudulently recorded that several more winning tickets had been sold. Then the fraudulent tickets had to be created. Since each selling machine is inspected after the track closes, a service person could punch in the "winning" tickets at that time to be cashed later. This scheme continued for years, with the cast of characters changing several times. Only an enormous amount of detective work solved this case, and just how much was stolen was never determined.

Why Is It So Easy?

Nearly every bank has armed guards, video monitors, tellers with alarm buttons, and numerous other security devices. A soft-drink distributor keeps delivery trucks fenced in, with a guard dog on night sentry duty. Why is it more difficult to rob a bank of $2,500 than to steal millions from its computers? Why are trucks locked up when almost anyone can enter the soft-drink distributor's computer room?

While many people may not believe that access to

The perpetrator of a crime can tell a questioning customer, manager, or auditor that the computer must have made a mistake.

computer centers is often easy, my experience proves this true. During a security consulting project at an Atlantic City hotel, I spent the evening with an associate in the casino. At about 11 p.m. we headed for our rooms, but the elevator stopped at the floor where the computer center was located and we decided to look around. The door marked "Computer Center—No Admittance" was locked but had a bell beside it. A computer operator opened the door when we rang, letting us in without a word. For the next ten minutes we wandered through the center without speaking to the operators on duty. Finally, we said "thank you" and left. They were lucky we were not disgruntled heavy losers!

Industrial security and bank security are fairly well understood, but computer security is not. History provides data from which to estimate the probability of a robbery occurring and the likely take, and this risk analysis shows the costs and benefits of using bank guards and sentry dogs. However, computer-related crime data are not widely available, making risk analysis harder. How much is a customer mailing list worth to a competitor? How much damage would be done if the inventory file were altered? How likely is a computer crime? All good questions with no good answers. Because computer crime data are not standardized or gathered in a central repository, analysis of the statistics is difficult. Also, the complexity and variety of computer systems means that a risk-analysis method for one system might not work for another, so security programs must be designed specifically for each organization.

Managers have contributed to the relative ease of computer crime as well—though certainly some do a good job in maintaining security—and controls over computer systems are generally weaker than in other areas of an organization. When computers first became important in business, many managers did not understand them and gave free rein to the data-processing people. Computer professionals became enigmas, assumed to be doing a good job because operations proceeded faster.

Managers also transferred this attitude to company auditors, who took the approach of auditing "around the computer." Transactions were carefully followed until they went into the computer and were picked up as they exited. Too often, traditional auditing controls rigorously enforced in manual bookkeeping systems were either eliminated or weakened in favor of the computer's speed. Other standard checks, such as separation of employee duties, have also been forsaken in many firms, partly because the computer's efficiency eliminated the jobs.

Fortunately, today more auditors are working "through the computer." These auditors write programs that can trace transactions or use auditing software packages now available commercially. Such new software packages enable auditors to identify any operator who gains access to certain data during periods when those files are normally closed. The programs can also detect employees with above-average overtime payments or highlight an abnormal number of correction entries, which often signal computer fraud. Most new auditors learn such skills, but they are playing catch-up since even the largest companies have only a handful of auditors who cannot be outsmarted by computer technicians.

Some managers have resisted additional computer security-control systems, considering them at odds with performance goals. Added controls might delay a computer's response by several seconds, and if 100,000 transactions are processed every day—such as at a large airline or bank—the extra delay per transaction becomes significant. A manager must maintain daily production, develop new processing systems, plan future growth, and handle personnel matters. As a result, planning for the rare possibility that a computer crime might occur—and installing the necessary security controls—does not receive much attention.

Finger pointing often occurs, and a well-known "you're-to-blame" loop has developed in the industry. Users of computer services point to computer specialists to solve problems. Computer people point to auditors, who point to computer management, who point to manufacturers. It's time to recognize that computer security is a management problem, and that only a coordinated effort will make computer crime more difficult.

Finally, computer crime prospers because of an underlying human trait. The perpetrator of a crime can tell a questioning customer, manager, or auditor that the computer must have made a mistake. Then the criminal can correct that transaction and continue with the fraud—since nearly everyone wants to believe that the computer is at fault.

What Does the Future Hold?

Perhaps the biggest change in business computer systems is the move to distributed data processing. Computers were once so expensive that they were installed

Training programs should stress that stealing with computers is no different from robbing the vault in person.

at a central site where all processing took place. Now the hardware is much cheaper and smaller, and computer terminals are distributed throughout an organization's various departments, electronically linked together and to a large central computer. Indeed, the number of terminals in the U.S. has more than doubled in the past five years to over 3 million, and operators can gain access to central computer files through most remote terminals.

With more processing sites, the problem of controlling computer access is faced many times rather than just once. Also, users are physically closer to the equipment, offering greater opportunity for uncontrolled use. And each site needs qualified managers, operators, and programmers—professionals who are in short supply—so companies sometimes settle for less-qualified individuals who do not understand or employ normal operating procedures.

To control user access, the most common step has been to issue secret passwords. But this is far from foolproof: for example, once individuals have been granted access to the computer, they often have total access. A rapidly growing market is now developing for access-control software systems that close such loopholes. This software restricts terminal users (identified by passwords) to only those files they are authorized to use, and users can perform only certain functions. What's needed is a system of checks and balances through the entire system: no programmer should test his or her own work, programmers should not operate equipment, and operators should not write programs.

The rapid increase in word processors and other components of the automated office, such as electronic mail and facsimile-transfer devices, also represent a security headache, since many of these devices are linked directly to a company's central computer. As chairperson of the Association of Computing Machinery's Special Interest Group on Security, Auditing, and Control, I have appointed a committee to organize a conference on office-automation security issues. Scheduled for October 1982, the conference is expected to draw participants presenting solutions to word-processing security problems.

Another technological development prompting security worries is the anticipated growth of teleworking systems, in which employees work at home or at neighborhood centers using terminals hooked electronically to a firm's central computer. (*See "Teleworking: Working Closer to Home," page 56.*) Then of course there is the rapid growth of home computers, which can be used to tap into commercial data-transmission lines. Five years ago just 1,500 personal computers had been sold in the U.S; today that number is 500,000, and by the mid-1980s the total should hit 3 million. Wiretapping was once considered a remote possibility because of equipment costs, but Motorola now gives bankers a demonstration of how data lines can be tapped using simple equipment bought at any computer store.

There is also the worry of accidental data-transmission "cross-talk." Think of a telephone conversation in which you can hear others talking on the line: the same thing sometimes happens in data communication, and in this way one party can gain information belonging to another company without deliberate criminal effort. The communications industry has been working on this problem for years, but no solution is in sight.

Keeping Messages Secret

To solve some of the security worries raised by distributed data processing and the transmission of electronic information, more emphasis is being placed on encryption or coding techniques. The National Bureau of Standards and IBM have developed the Data Encryption Standard (DES), a mathematical model that can be implemented (via software or a microcomputer chip) into a coding device. Each DES user has a "key"—a list of 56 zeroes and ones—that enables a message or data to be coded, and anyone who knows that key can decipher the information. So in banking, for example, a financial transaction is coded and transmitted to another bank's computer, which uses the key to produce the original message. Perhaps $400 billion is transferred each day around the nation using such systems.

All encryption schemes can be broken, however, and the work required to break a code depends largely on the length of the key. Supporters of DES claim that the effort required to learn the key, using a computer trial-and-error approach, is so great that no one would ever succeed. But some critics claim that the workload is not so great, and the payoff in cracking the encryption schemes for electronic funds transfer systems makes the effort worthwhile.

One possible solution, suggested by Leonard Adelman of the University of Southern California, is to use a newly developed "keyless" encryption method. Although safer, the system requires that the message *(Continued on page 30)*

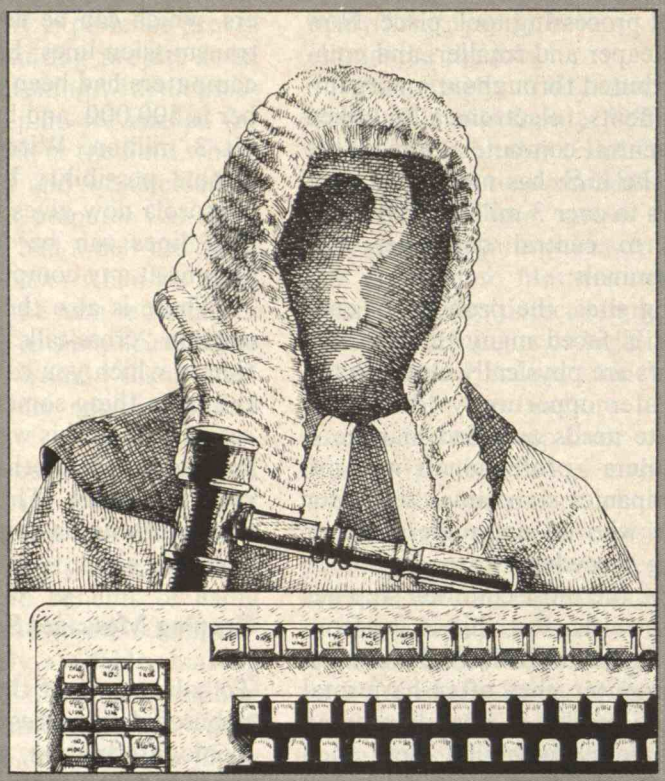
Computers in Court

by Karen A. Frenkel

With some 12,000 computers humming away in various government branches in 1976, Abraham Ribicoff, then a U.S. senator from Connecticut, sensed a tempting target for data defrauders and instituted an investigation into federal computer security.

What he found alarmed him. An Internal Revenue Service employee had used a computer scam to embezzle $650,000 before being caught. And government auditors routinely testing security at the Social Security Administration, one of the world's largest computer facilities, were able to make off with computer tapes containing the names, addresses, and histories of more than a million beneficiaries.

The criminal justice system was ill-equipped to detect, investigate, or prosecute computer fraud, Senator Ribicoff declared. Some 40 federal statutes could be used to combat swindlers, but most of these predated the computer revolution. "Federal prosecutors are handicapped," he said, "because there is no law making computer crime a crime."



The First Act

In 1977, Senator Ribicoff introduced the Federal Computer Systems Protection Act. Designed to "give federal prosecutors a better weapon," the bill attempted to define computer crime and outlined penalties for offenses. It covered four major criminal categories: introduction of fraudulent records or data into a computer system; unauthorized use of computer-related facilities; alteration or destruction of information or files; and stealing, by electronic or other means, money, financial instruments, property, services, or valuable data. Convicted criminals could be fined up to two and a half times the amount of the fraud and imprisoned for 15 years.

The bill would allow the federal government to prosecute a suspected criminal if the computer involved is owned or operated by the U.S. government or a federally insured financial institution. The government could also prosecute if the computer is operated in interstate commerce or makes use of a "facility of interstate commerce" such as telephone lines. However, the bill has never been voted on by either branch of Congress, but continues to totter back and forth between committees.

Early drafts of the bill were scrutinized by trade associations, law-enforcement officials, and computer-crime experts. A typical criticism is provided by Steven Jost, director of the Washington office of the 30,000-member Data Processing Management Association (DPMA): besides including pocket calculators and digital watches in its definition of a computer, the proposed bill "allowed the government to suggest licensing and certification of computer professionals. We felt that this was a matter for the industry, not the government." Jost also said there was concern that "the bill did not include misdemeanors. No matter what type of abuse took place, even if it were creating a Snoopy calendar, everyone would be subject to the same felony penalties."

Revised Edition

The Ribicoff bill's most recent draft (1980) clarified the computer definition, excluding those "for routine personal, family, or household purposes, including portable hand-held electronic calculators." Reference to professional certification was deleted and penalties were reduced to twice the amount of the loss or $50,000 (whichever is higher) and five years in jail. But the bill's sponsors did not budge on the felony issue. Among their many reasons is that even seemingly innocuous activities, such as reproduction of copyrighted material, can indeed be criminal—adding that similar acts committed without computers have traditionally been considered felonies.

Industry critics seek other refinements of the bill as well, arguing, for example, that its language and intent would both burden managers and prevent the establishment of effective standards. Managers would be forced to determine what is authorized and prohibited at their particular facility, says lawyer Jay T. Westermeier, chairman of DPMA's computer-crime subcommittee. "They would be de facto legislating what is and is not a crime. We think that puts too great a responsibility on managers." Firms allow employees access to their computer systems based on varying management philosophies. One firm might be flexible, reasoning that programmers spending computer time on games or personal taxes attain greater fluency with the system's capabilities, perhaps leading to creative benefits for the company. But another firm, choosing to conserve both computer time and employee time, might forbid nonbusiness activities. According to Westermeier, the bill "would result in having all the elements of a crime at one installation and not at another."

The bill also seems to have revived the battle over federalism versus states' rights. Robert Bigelow, a computer law specialist, says it would allow the federal government to determine legal jurisdiction: "federal prosecutors could

pull a case out of the state and say 'it's our case. Period.'" Lee Faukey, board chairman of the National District Attorneys Association, told the Senate Judiciary Committee that the bill "projects itself too much into local government matters." And one state attorney general suggested that the bill be amended to apply only to federal computer systems.

Prosecution Complex

But the bill's proponents argue that legal complications and delays are a common problem for *local* authorities dealing with computer crime. As one of the most sophisticated types of white-collar crime, electronic piracy presents major difficulties in structuring legal indictments, says Richard Raysman, chairman of the New York Bar Association's Computer Law Subcommittee. "This discourages local prosecutors, who frequently have absolutely no knowledge of computers."

He cites a California case in which a computer-service company employee challenged the state's charge that he stole a trade secret. The state alleged that the defendant had obtained, via telephone lines, a printout of another company's $5,000 confidential program. The defendant contended that the program did not constitute a trade secret and that he could not be convicted as charged. The prosecution introduced considerable evidence, and, according to an account in the *Rutgers Journal of Computers, Technology, and the Law*, the judge went through "tortuous mental and statutory gymnastics" before deciding that "probable cause existed to believe the program was a trade secret."

Raysman believes that the Ribicoff bill should be passed, since without it "the federal government needs an excuse, a peripheral statute such as income-tax evasion, mail fraud, or wire fraud, to get involved." But waiting for local lawyers or district attorneys to demonstrate that a federal statute has been violated takes time, and their attempts often fail, especially when they are unfamiliar with computer-crime cases. Some states do have specialized white-collar crime legal groups, but they are generally small and understaffed. Raysman says the bill would allow the federal government to get involved immediately, when computer expertise is most needed.

Also on the local level, law-enforcement officers are preparing for communications snags in computer-fraud cases. Lieutenant Edward Shea and Detective Joseph Gannon of the New York City Police Department's Special Frauds Squad have taken FBI courses to help them present such cases clearly to district attorneys and grand juries. Says Shea: "The detective is often the key person in the investigation. If he cannot effectively translate technical jargon, the investigation may die. I imagine that happens in a lot of cases."

Shea and Gannon are convinced not only that computer crime will increase but that organized crime's intrusion is also inevitable. "Historically, watching their involvement in white-collar crime, computer crime is next," Gannon says. Since many companies prefer to absorb their losses and settle out of court, "These criminals know there's money in it and that it's treated as a soft crime. They also know their chances of being caught are comparatively small today."

Commenting on the Ribicoff bill, Shea says he doesn't "believe in legislation for its own sake, but legislation brought about by need is positive. We need it. When you live in an electronic age, you must adapt to it."

But adapting by enacting new laws may not be the best solution, according to Bigelow. He says there are certainly some situations where laws aimed at a specific crime can be helpful, but he maintains "a general skepticism about more and more laws. There already are several state computer-fraud laws but there haven't been any prosecutions." Others say the bill overlaps existing laws. For example, the 1974 Privacy Act subjects those who fraudulently acquire information from a federal agency to a $5,000 fine. (However, penalties for the same offense would be much more severe under the Ribicoff bill.)

Congressional Record

Ribicoff retired in December 1980, leaving the bill without a sponsor in the Senate. But Representative Bill Nelson, who sponsored the first state computer-crime bill in his native Florida, has introduced an almost identical bill into the House. Informal comments were submitted last October in preparation for hearings early in 1982 by the House Judiciary Committee.

But some observers fear that Congress, largely occupied with budget and tax matters, lacks the impetus to act soon. Rep. Nelson hopes interest in computer crime can be rekindled, but says that current interest seems limited to those already knowledgeable. Nevertheless, he and his staff are talking up computer-crime legislation and want to gain cosponsors in the Senate. Says he: "This is a starting point for discussion, fine tuning, and education."

Partly because of this federal foot dragging, some states are taking their own legislative steps. Since 1978, 11 states have adopted computer-crime laws roughly patterned after the Ribicoff bill, and others have legislation pending. (Arizona, California, Colorado, Florida, Illinois, Michigan, New Mexico, North Carolina, Rhode Island, Utah, and Virginia have passed laws. Those with pending legislation include Hawaii, Maryland, Massachusetts, Minnesota, Missouri, New York, Pennsylvania, and South Dakota.)

While their actions might be well intentioned, Dr. Leslie Ball of Babson College cautions that "there is some danger the states will write legislation contradicting federal laws that eventually will be passed." He suggests that there should be a "clearinghouse" responsible for coordinating legislation to ensure that laws are written in proper technological terms and can be enforced. "Without such precautions, the cost of complying with legislation could be substantial and will, of course, be passed on to consumers in the form of increased prices."

It may be that the law, inherently reactive, will always be outrun by technology. Clearly, the legislative learning curve is not as steep as the computer industry's. But the bill's history illustrates the unusual challenges presented to lawmakers, lawyers, and the courts. They will continue to face a triple bind: learning about a complex technology, balancing a variety of viewpoints, and yet not unduly hampering an industry innovating at an unprecedented pace. □

Karen A. Frenkel is a freelance writer living in New York City. She holds an M.S. in science communication from Boston University.

Adequate security must be a management priority if our nation's growing reliance on computers is to be safeguarded.

(Continued from page 27)
be transmitted three times, greatly increasing the work load associated with data transmission.

It seems likely that DES is adequate for virtually all the information transmitted electronically today. The problem is that few companies actually use such techniques because of what they perceive as high cost and difficult operation. But in reality DES hardware units cost less than $200, and coding a transaction requires no extra work since the unit does it automatically. In fact, all automated bank teller machines use these devices.

Should There Be a Law?

A computer criminal seldom goes to court and even less often goes to jail. Companies often do not prosecute, feeling that customers might react unfavorably to perceived security lapses and take their business elsewhere. Also, the current legal definition of certain crimes may not accurately cover computer fraud. For example, in conventional theft the item is physically removed from the victim. However, theft of computer information often involves copying the data but leaving the original tape or disk. Even when a fraud is suspected, gathering evidence is often difficult, and that evidence is not easily understood by a judge or jury.

Because current laws are inadequate, much activity has been occurring in both state and federal legislatures. For example, Congress has been considering for several years the proposed Federal Computer Systems Protection Act, which calls for stiff penalties for computer crime (*see page 28*). Also, just before the Foreign Corrupt Practices Act was passed in 1978 to prevent American companies from bribing foreign officials, the Senate added a brief section requiring adequate controls on company accounting records. The Securities and Exchange Commission (SEC) has interpreted this legislation to mean that all SEC companies must have internal financial controls. If such controls are missing, top corporate officials are subject to prosecution and prison sentences. (Any company with publicly traded stock is subject to SEC review at any time.) Since most companies use computers to keep their accounting records, this law seems directed primarily toward computer security.

Other legislation protects computer data from criminal activities in certain industries or branches of the federal government. For example, the Food and Drug Administration regulates "how computer systems used in manufacturing, packing, and storing drug products should be operated and controlled." This regulation, directed at a single industry, has generally been effective.

Computer professionals must take the lead in the drive to improve computer security. As each computerized system replaces a manual system, the potential criminal is provided another opportunity. Programmers, systems analysts, and others developing new computer systems must be trained in company-sponsored or industry-sponsored programs on security-control measures. More auditors with computer training are needed. Just as programmers need to understand controls, auditors need to understand programming, allowing them to participate in the development of new security systems. A healthy working relationship between programmers and auditors will go a long way toward solving the problem.

Computer users, soon to be nearly everyone in many organizations, must be instilled with a healthy respect for computers. They must understand the computer's potential and proper use, and training programs should stress that stealing with computers is no different from robbing the vault in person.

Educational institutions should take similar steps, giving more attention to computer ethics, especially since more than 400,000 college students graduate each year with computer experience. Some teachers now encourage students to break into the school's computer data base, under the misguided belief that this helps them better understand how the system operates. However, teachers can achieve this goal through more positive action. In my own classes, for example, I teach students how to monitor the flow of transactions and why controls are important.

The overriding point is that the tools to stop most computer crimes are available. Encryption devices can be purchased and security measures can be adapted from other industrial situations. Legislation is being improved, though slowly. Missing, however, is support from top-level management. Along with strategic planning and new product development, adequate security must be a management priority. That kind of attention is essential if our nation's growing reliance on computers is to be safeguarded.

Leslie D. Ball is associate professor of information systems at Babson College and a partner of Information Resource Management Associates, a consulting firm, both in Wellesley, Mass. He has a Ph.D. in information systems from the University of Massachusetts at Amherst.

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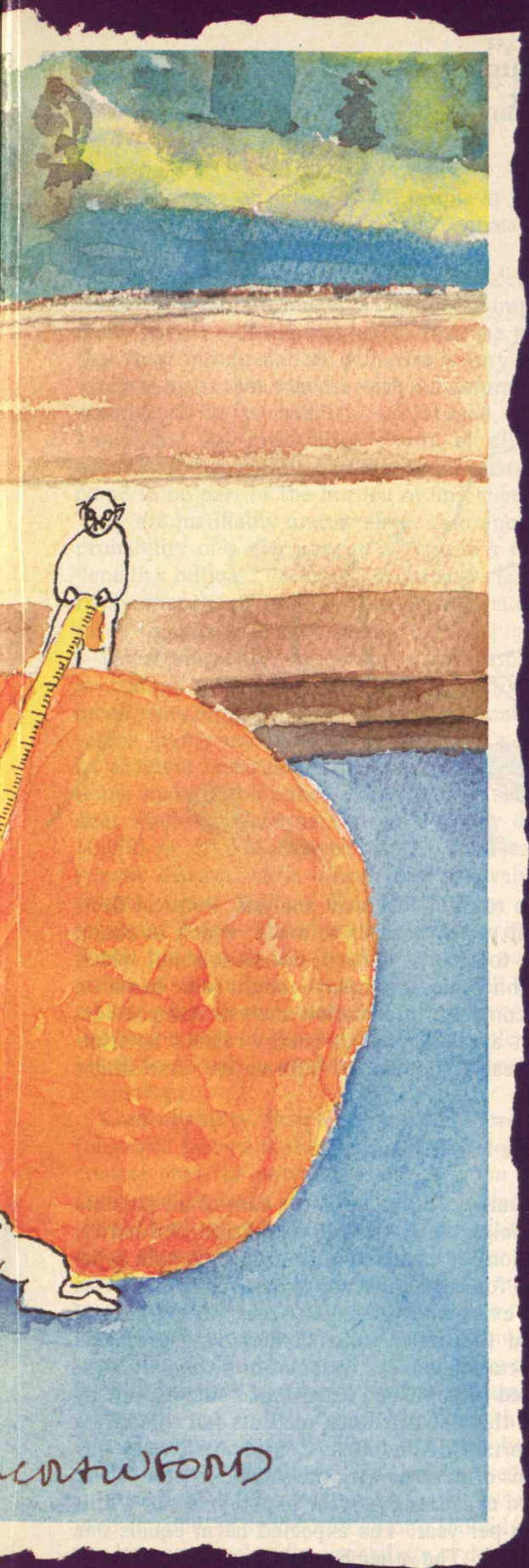


Energy Hazards: What to Measure, What to Compare

by John P. Holdren

Comparing energy hazards is like comparing apples and oranges. Analysts must account for qualitative differences in environmental effects, numerical uncertainties, and a range of social goals.

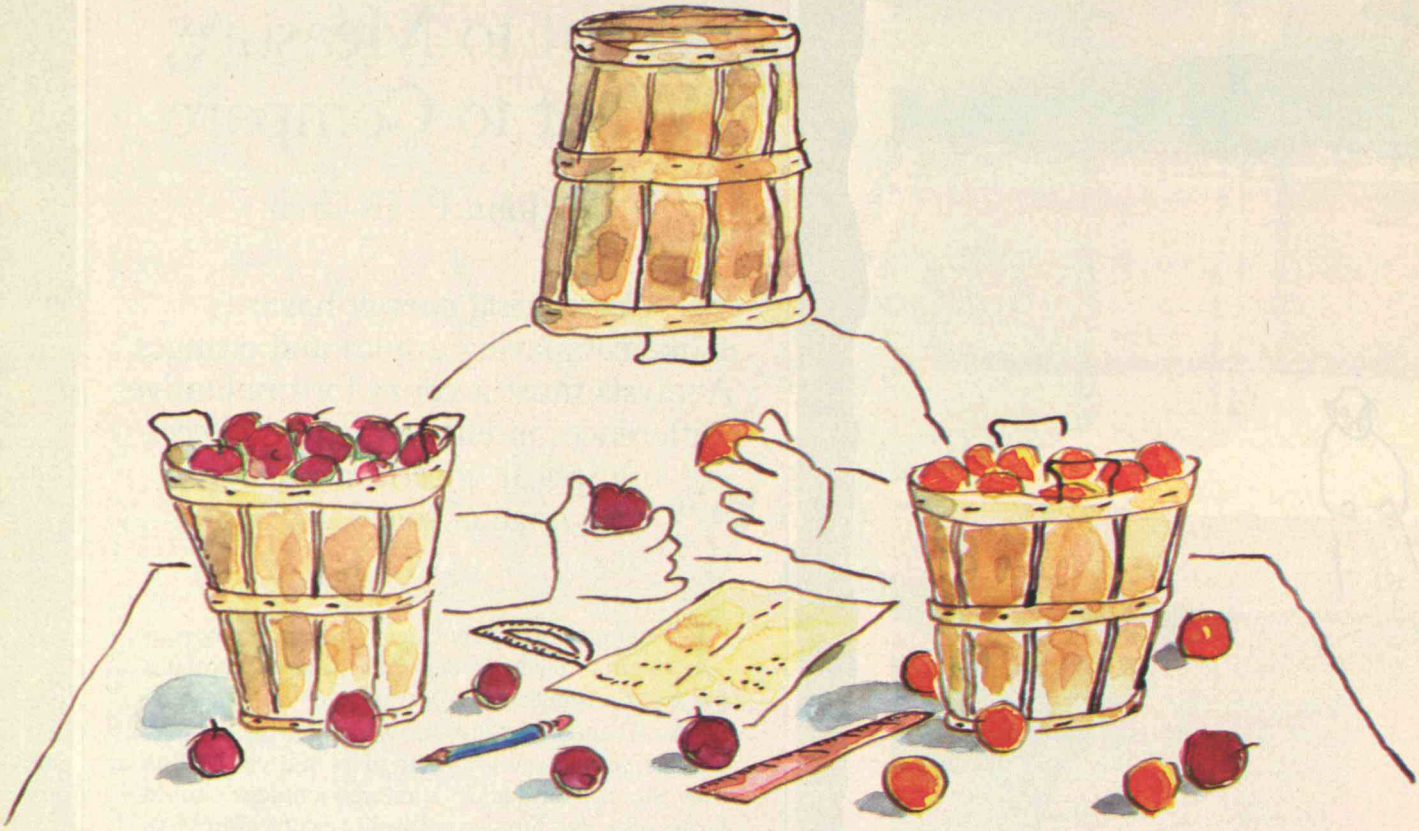
THE increased attention to energy's environmental hazards over the past decade has not been a temporary aberration or fad, as some in the Reagan administration appear to believe. Rather, it has resulted from growing recognition that the aim of society's energy choices should be to increase human well-being, not simply to increase energy supply for its own sake. Since well-being is as profoundly influenced by environmental conditions as by economic ones, a sensible energy policy must seek to avoid not only the economic hazards of having too little energy, but also the environmental hazards of having too much or the wrong kinds.

No energy source known or imagined is free of environmental hazards. (I construe "environment" broadly to include sociopolitical as well as biological and geophysical conditions.) These hazards arise from many different stages of the energy-supply chain (such as mining, transport, processing, and combustion), propagate through various environmental media (such as air, water, and soil), and cause many different undesirable effects (such as occupational and public disease, property damage, and disruption of ecological and sociopolitical conditions).

Unlike energy's economic costs and benefits, its environmental liabilities usually do not lend themselves to monetary characterization. Some

ILLUSTRATIONS: MICHAEL CRAWFORD

Analysts may confuse things that are countable with the things that count.



environmental effects are resistant to quantification of any sort. Others are susceptible to quantification in principle but pose difficulties in practice because the links between cause and effect are poorly understood. And even when environmental damages can be quantified rather precisely, it can be difficult or impossible to compare one category of harm with the next. How, for example, does one compare tons of soil eroded because of deforestation for fuelwood with accidental deaths in coal mining? In a few cases, conventions have been developed for determining the dollar "cost" of a human death, a day of illness, or a lost recreational asset, but the inevitable value judgments embedded in such conventions make them a continuing subject of dispute.

Because no single index, monetary or otherwise, is suitable for evaluating the diverse array of environmental hazards of energy sources, comparing those hazards with one another is like comparing apples and oranges: it is a matter of personal values as well as of technical judgment. Consequently, decisions about which hazards to accept, which to abate, and which to avoid are inevitably partly political, as are other social choices in which individual values conflict.

Of course, this observation does not mean that there is no role for technical analysis. Political decisions about which hazards to avoid, which to abate, and which to accept—indeed, decisions about which energy technologies to employ—ought to be based on the most complete information analysts can provide. But which attributes of an energy-related environmental hazard should an informative assessment include?

One Chance in a Million

Expected harm. This value is the sum of all possible damages weighted by their probabilities. Ordinarily, an expression for expected harm might contain separate terms for each different type of harm, such as loss of life expectancy in person-years, person-days of illness, and the dollar value of destroyed property. Such expectation values are sometimes the *only* indices provided in published hazard assessments, but by relying on this one attribute, analysts fail to address some important distinctions. Consider two very different kinds of hazards with the same expected harm: One hazard consistently—year in and year out—kills one person per year. The expected harm equals one death per year. The other hazard has a probability of

People seem to be more willing to tolerate a hazard if they think they have substantial control over the outcome.

0.001 per year of killing 1,000 people at one stroke. The expected harm in this case also equals one death per year.

Maximum harm. What will happen under the worst conceivable circumstances is considered important by many people, despite assurances that the probability that these circumstances will arise is very low. Some analysts insist that concern with maximum harm irrespective of its probability is irrational, but people know that low-probability events of all kinds *do* occur, and they rightly consider the "worst-case" outcome to be part of the burden of any energy choice. They are justifiably uneasy about assurances that the probability of a given event is "one in a million" or "one in a billion," because they know, at least instinctively, that the probability that the analyst is wrong is often significant in such cases.

Uncertainty. In many cases, the information used to compute the maximum and expected harm is incomplete or deficient in other ways, rendering both values highly uncertain. This situation is illustrated by accident hazards at commercial nuclear reactors. Some analysts think the "worst case" in such an accident would produce perhaps 1,000 early deaths and 10,000 or 20,000 delayed deaths from cancer and genetic disease, while others place the values ten or twenty times higher. The uncertainty about the *expected harm*—based on all possible reactor accidents, big and small—is even greater: perhaps five orders of magnitude, from 0.0002 to 20 deaths per reactor-year. In such cases, the uncertainty itself is an important part of the burden that people are being asked to accept in exchange for the benefits of the technology.

Controllability. People seem to be more willing to tolerate a hazard if they think they have substantial control over the outcome (such as when they drive their own car or fix their own rooftop solar collector) than if control is largely out of their hands (such as when they fly in a commercial airliner or live near a liquid natural gas terminal). Hazards amenable to managerial or technical controls also are often given less weight than risks resistant to such controls. Thus, many thoughtful observers rank the risks of weapons proliferation and nuclear terrorism high among nuclear hazards, not only because they think the expected and maximum harm is high, but also because the amenability of these hazards to control seems low.

Distribution. Hazards vary in how they are distributed in time, in space, and among individuals. Harm can be acute or chronic, immediate or delayed, reversible or irreversible. It may be local, regional, or global, and it may range from uniform to highly nonuniform within the affected area. And harm may discriminate between rich and poor, between the medically susceptible and the population as a whole, between those who have a voice in the selection and management of energy sources and those who do not, and between the present generation and future ones. Many of these distributional characteristics pose awkward dilemmas for policymakers.

A Risky Business

Many studies of energy-related environmental hazards have been published in the last ten years. Coal and nuclear fission have been examined most frequently, although virtually all other energy sources—oil, natural gas, oil shale, geothermal energy, fusion, the whole array of renewable sources, and conservation—have received attention. Although some of these studies have established a partial foundation for informed decision making and future assessment efforts, some have been so deeply flawed as to be worse than useless. Among the pitfalls found even in some of the best studies (and pervasive in the worst) are the following:

Apples and oranges—noncomparable energy benefits. The most informative approach is to compare alternative energy systems that produce the same energy benefits in the same time frame. For example, it is useful to compare long-term electricity sources such as fusion, fission fast breeder reactors, and ocean thermal energy conversion, and to compare short-term sources of liquid fuel such as imported oil, offshore domestic oil, and alcohol from grain. But knowing that energy source A is less hazardous than source B is of little use if A will soon be exhausted and B is not yet available but eventually will be able to meet civilization's needs for millennia. And comparing the hazards of obtaining a kilojoule of electricity to the risks of obtaining a kilojoule of liquid fuel is not very informative. The two energy forms are not directly interchangeable in most applications, and one form cannot be transformed into the other without additional processing that entails further environmental impacts.

Apples and orangutans—energy hazards versus nonenergy hazards. Energy-related environmental hazards are often compared with other environmental hazards that have nothing to do with energy, such as the chance of being hit by a meteorite or being killed

The hazard-assessment community has been far too tolerant of shoddy work.

in an earthquake. Sometimes such comparisons are intended simply to provide some more familiar yardstick against which the energy hazard can be measured. Comparisons of energy and nonenergy hazards also may be useful in assigning priorities for the allocation of society's resources for hazard abatement. (In the latter case, however, what matters is not the absolute size of the hazard but rather the amount by which each hazard can be reduced with a given expenditure of funds—quite a different index.)

All too often, though, the explicit or implicit intent of comparisons of energy and nonenergy hazards is to convey a message about the "acceptability" of the energy hazard. If, for example, people in California accept such-and-such a risk of being killed in an earthquake, why should they not accept a much smaller risk of being killed in a nuclear-reactor accident? The fallacy here is that the benefits obtained by accepting the hazards being compared are qualitatively different. Many people knowingly accept California's earthquake risk because they believe that in living there they obtain a combination of benefits—climate, scenery, work opportunities—not obtainable in any other way. By contrast, the benefit of nuclear reactors is simply electricity, which can be obtained in a number of other ways. The most informative comparisons for nuclear power's hazards are with the hazards of other sources of electricity and with the hazards people accept from electricity at the point of end-use.

Inconsistent system boundaries. Where the aim of an assessment is to identify the most hazardous fuel-cycle steps associated with an energy source so that efforts at hazard abatement can be focused where they are most needed, it makes perfect sense to analyze mining, fuel processing, and fuel transport one at a time. However, where the aim is to total up the environmental costs associated with one energy source, or to compare the environmental costs of one energy source with another, all fuel-cycle steps and associated activities must be included.

This elementary principle has often been neglected. A particularly drastic example was the widely publicized comparison of hazards of renewable and nonrenewable energy sources by Herbert Inhaber (*see "The Risks of Risk Assessment," May 1979, page 82*). This analysis included the occupational hazards of materials acquisition and facility construction in the total risk for renewable sources but omitted these hazards in the totals for nonrenewables.

A less transparent example of the inconsistent-boundary syndrome is the much-cited calculation that a coal-burning power plant produces a greater radiation hazard than a properly operating light-water reactor, owing to the coal plant's release up the stack of uranium and thorium (present as trace contaminants in the fuel). This conclusion results from including the main source of radionuclide emission in the coal fuel cycle (the power plant) but excluding the activities in the nuclear fuel cycle (mining, milling, and reprocessing) that account for 90 percent of the routine emissions caused by nuclear generation of electricity.

Confusion of average and marginal hazards. If the aim of an assessment is to determine the impact on society of past energy choices, it is appropriate to *average* the effects of existing facilities and practices. On the other hand, if the aim is to help determine what energy technologies should be developed in the future, it is necessary to assess the effects of *new* facilities and practices—that is, the effects "on the margin."

Like maintenance of consistent system boundaries, this elementary dictum has often been ignored. Thus, the operation of modern nuclear facilities is commonly compared with the operation of older coal facilities using equipment, conditions, and practices that would not be tolerated in new ones. The environmental effects of new coal mines and power plants, meeting present mining regulations and performance standards, are much smaller than the effects averaged over all existing facilities.

Excessive aggregation of hazards. Combining dissimilar hazards into a single index of harm may submerge important distinctions. For example, occupational and public hazards should not be combined, because they generally differ in the extent to which the risks are borne voluntarily and in the degree of compensation bearers receive. A more subtle form of overaggregation is the totaling of numbers of public or occupational deaths without regard for the great differences in loss of life expectancy associated with different causes of death. For example, death from aggravation of a preexisting respiratory disease in an air-pollution episode may claim only months of a victim's life, while a typical cancer might claim 10 to 30 years and a typical accident perhaps 20 to 40 years.

Illusory precision. One of the most striking and pervasive shortcomings in assessments of energy hazards is insufficient attention to variations and uncertainties associated with "best estimates." *Variations* arise from predictable differences in conditions such

The Hazards of Electricity Generation: Case Studies in Illusory Precision

THE Nuclear Regulatory Commission's Reactor Safety Study (RSS, popularly known as "the Rasmussen report") produced a "central estimate" of 0.024 deaths per reactor-year for the expected loss of life (early fatalities plus delayed cancer deaths) from accidents at commercial light-water reactors in the United States. This widely quoted figure consists essentially of probability times consequences, totaled over all identified possible accidents and averaged over 100 reactors at 68 sites. In approximate terms, the figure can be thought of as the probability of a core meltdown multiplied by the average consequences of such a meltdown. The RSS asserted "90 percent confidence" that the true probabilities were not less than five times smaller nor more than five times larger than its central estimates, and that the true consequences were not less than six times smaller nor more than three times larger.

These uncertainty bands have often been omitted entirely from popular and semipopular discussions of reactor safety. But several expert reviews conducted since completion of the RSS in 1975 have concluded that its uncertainty bands are in fact greatly understated. Although the statistical considerations involved are too detailed to lay out here, it is not difficult to show that the "correct" expectation value of loss of life for the 100-reactor case could be anywhere from about 100 times smaller than the RSS central estimate to about 1,000 times larger—a range extending from 0.0002 to 20 deaths per reactor-year, even excluding the unquantifiable chance of sabotage. In addition, the *variation* in expected loss of life between the best and worst individual U.S. reactor sites is more than a factor of 1,000.

Illusory precision is also rampant in published estimates of the deaths attributable to emissions of sulfur oxides and particulates from coal plants. One can find in the literature virtually any number between zero and four hundred excess deaths per large coal-burning power plant per year, often unaccompanied by any statement whatever about assumptions or range of uncertainty.

Most of these figures are based on one of two different dose-response relationships connecting average ambient concentrations of sulfate particulates (assumed but not proven to be the key explanatory variable) and excess mortality. One of those dose-response relationships, put forward by the Biomedical and Environmental Assessment Division of the Brookhaven National Laboratory, gives a median estimate of 3.7 excess deaths per year per 100,000 people exposed to an average annual increment of 1 microgram of sulfate per cubic meter of air, with an uncertainty range that extends from 0 to 12. The other dose-response relationship, put forward in a 1975 National Academy of Sciences study, yields a figure of 0.2 excess deaths per year per 100,000 people per microgram per cubic meter, with an uncertainty range extending from 10 times smaller to 2 times larger.

The difference in these estimates is even larger than suggested by those numbers, however, because Brookhaven assumes that each death represents a loss of 5 to 15 years of life expectancy, while the National Academy assumes that each death represents a loss of only weeks to months. (Brookhaven assumes that sulfate is a partial *cause* of cardiovascular and respiratory disease. But the academy study found the data in support of this view unpersuasive, and assumes that sulfate only aggravates preexisting disease by killing, in air-pollution episodes, people already near death.)

This difference in the "best estimates" of the public-health consequences of sulfate exposure—a factor of nearly 20 in number of "excess" deaths multiplied by a factor of perhaps 100 in mean loss of life expectancy (10 years versus 1 month)—is enormous. However, the total range of possibilities for the consequences of sulfur emissions from coal-burning power plants is even bigger. There are the large uncertainty ranges surrounding each of the two best estimates, and there is a further uncertainty factor of at least 20 in the relationship of emissions of sulfur dioxide to ambient concentrations of sulfate. There is also a variation of a factor of 5 in population exposure between the worst U.S. coal-plant site and the average such site, as well as a variation of about a factor of 10 in the sulfur content of coals widely used for electricity generation. Finally, there is a variation of a factor of 10 in emissions between a plant with no stack-gas sulfur control and a plant with the best available stack-gas control.

Clearly, the variations and uncertainties in both the reactor-accident and the sulfate-disease cases are so large that single "best estimates" of the consequences are likely to be highly misleading. Unfortunately, such illusory precision is still being propagated in many assessments of the hazards of energy supply.—*J.P.H.*

as pollution-control technologies, management and safety practices, fuel composition, and sites. *Uncertainties* arise from imperfect knowledge about the performance of a given technology and the cause-and-effect relationships linking that performance to environmental consequences. Together, uncertainties and variations can produce wide ranges of values spanning four orders of magnitude or more for such key hazards as public disease from oxides of sulfur and deaths from reactor accidents. Yet all too often, published assessments offer estimates of these hazards to two-decimal-place precision with no statement whatever about the real range of possibilities.

Preoccupation with the quantifiable. Analysts tend naturally to focus on the environmental effects easiest to quantify. In general, occupational impacts are quantified more easily than public ones, injuries more easily than illnesses, immediate damages more easily than delayed ones, and direct damages from accidents and effluents more easily than indirect damages from disruption of biogeophysical and sociopolitical conditions. But quantifiability and relative severity are

The fact that personal values inevitably influence the evaluation of energy alternatives does not imply that one "opinion" is as good as another.

often unrelated or even inversely correlated, and analysts preoccupied with the quantifiable may confuse things that are countable with the things that count.

Nuclear power and coal provide telling examples. The likelihood of successful sabotage of a nuclear reactor is difficult to measure, but this path to disaster may well prove more important than the intricate mechanical failures more easily studied. Terrorist theft and misuse of nuclear materials could rip the fabric of society far beyond any accidents at repositories for radioactive wastes, but the latter, being easier to quantify, receive far more attention. The spread of nuclear weaponry among nations is arguably nuclear power's biggest liability, both in terms of expected harm and maximum conceivable harm, but it is excluded from many studies because it is difficult to quantify.

The biggest threat to human well-being from coal burning is almost certainly the possibility of large-scale climate change induced by the accumulation of carbon dioxide in the atmosphere. While some aspects of this problem can be studied quantitatively, the estimation of human consequences is nearly impossible. Similarly, disruption of ecosystems by coal-related acid rain may do far more harm to societal well-being than worker deaths in coal mining. However, the latter damages are included in every assessment of coal's hazards, while the former, resisting quantification, are often excluded.

Hidden values. As mentioned, choices among energy alternatives cannot be made without the introduction of tastes and values. Whether you prefer an energy source that slightly increases the chance of nuclear war or one that poisons one in ten thousand of its users depends on your personal preferences and aversions. Such choices are not the province of analysts; they belong properly to the public, which expresses its preferences through the political process. But many analysts tend to make these choices on the public's behalf, intentionally or unintentionally, by omitting those hazards that they have decided are uninteresting, too difficult to quantify, too speculative, or too likely to be "misinterpreted." Such omissions hide the analysts' values in the way the assessment is conducted and presented, thus biasing the outcomes.

Toward Better Energy Decisions

Sensible choices about energy sources will require both better information about environmental characteristics and better use of this information in the selection of energy options. Here are some suggestions to facilitate improvement on both fronts.

Subdividing the problem. Both the hazard-assessment and decision-making processes would benefit from a clearer demarcation between the task of the analyst and that of the decision maker. Hazard analysis consists of the identification of ways energy technologies produce environmental damages and the characterization of those damages in all their dimensions. This work is the province of technologists and environmental and social scientists; it requires the exercise of technical judgment but not values, and the result is descriptive. Hazard evaluation—the political weighing of partly incommensurable costs and benefits and their distribution—is the province of the public and its decision makers. Hazard evaluation cannot escape value judgments and the result is prescriptive, in that rankings of hazards and their costs and benefits suggest specific choices or courses of action.

Facing up to uncertainty. Analysts and decision makers should declare with one voice that hazard estimates unaccompanied by measures of associated uncertainty are next to useless. To the extent that such uncertainty is not presented clearly and hence is not taken into account by decision makers, sensible choice is imperiled. Moreover, analysts should estimate the time and effort needed to reduce large uncertainties, so that decision makers can choose between making a decision immediately and waiting for better information.

Controlling quality. The hazard-assessment community has been far too tolerant of shoddy work. If the field is to maintain professional respectability and social usefulness, analysts must call attention forcefully to work that is so careless or conceptually flawed that it misleads rather than illuminates. The fact that personal values inevitably influence the *evaluation* of multihazard energy alternatives does not imply that one "opinion" is as good as another in the *analysis* of the hazards.

Integrating environment and engineering. Many energy technologies now in widespread use were developed in an era when environmental effects were peripheral issues at best. The subsequent emergence of environmental hazards as a central factor in the energy predicament—indeed, as the tightest constraint on many energy options—has led to the use of a wide variety of "add-on" hazard-control technologies and management practices. These measures often have produced bigger economic penalties and smaller (*Continued on page 74*)

Soft Energy Technology Is Hard

by Henry Petroski

As with Claes Oldenburg's soft electric fans and other pop art sculptures of the 1960s, there is an incongruity of scale and medium among the hard prototypes of soft technological windmills for the 1980s. Known as "wind energy conversion systems," or WECS in acronym, they will evolve into wind turbines whose blades will span a football field and put windy little towns like Boone, N.C., where one of the world's largest windmills is presently generating electricity for the local power grid, on the map. However, even the early prototypes are pointing up the critical role engineers and other hard technologists will have in charting viable soft paths into an unmapped energy future.

In 1973, in the wake of the Arab oil embargo but before the soft-path metaphor entered the vocabulary of concerned citizens, the National Science Foundation sponsored a project to explore the potential of wind power. Whether the wind turns a blade on a stationary turbine or a propeller pulls an airplane through a relatively quiescent atmosphere is six of one and half a dozen of another to an engineer concerned with developing reliable and efficient blade designs, and NASA's Lewis Research Center was a logical choice for the project's early home. However, the Department of Energy subsequently took over the effort to convert free wind energy to electricity on a practical and economical scale that would ultimately be attractive to utilities. Hence the dual logos of NASA and DOE on the Boone wind turbine, which sits on a 140-foot tower atop the Blue Ridge Mountains and can generate 2,000 kilowatts in 25-mile-per-hour winds. To some, it is a beautiful sight; to others, the noise is so aggravating that the hours of operation have been curtailed.

Paying the Toll

The so-called soft energy paths are of course those along which the society relies upon elemental sources, such as water, wood, and wind, to generate power, heat, and electricity, preferrably on a decentralized basis. This is in contrast to the hard paths, along which energy is produced primarily from the likes of oil and nuclear fuel at large centralized generating stations. The soft and hard paths are now competing for the energy traffic of the future, and, since they are largely parallel roads, the principal attraction of one over the other appears to be the tariff at the toll booth.

At present the hard path, generally believed to be open and paved all the way through the next century, is not only the quicker but also the more reliable and cheaper route for most. Still, some who prefer the quaintness and pace of old-time rural America voluntarily choose the soft path, much as they might prefer to take U.S. 40 over Interstate 80 between Chicago and New York. However, those same travelers would not like to hear the drone nor see the towers of wind turbines every several hundred feet along the Blue Ridge Parkway.

Thus, advocates of hard energy paths are not just tilting at windmills when they accuse soft-path proponents of being a little quixotic. To meet modern power requirements economically and conveniently, alternative energy systems must be conceived on a large scale. It would not be practical or economical, nor would it be pleasing to the eye, to put a small windmill, like a television antenna, on every rooftop. Tomorrow's windmill designs must be real, and not just imaginary, giants that tower over hundreds of families and deliver power for under a nickel a kilowatt-hour.

Softening the Blow

While the soft energy path may be lined with tulips and quaint Dutch windmills for some, for others it passes right through the giant steel structures suppporting WECS, much the way paved roads tunnel right through giant redwoods in Sequoia National Park. Yet the tips of the blades of this new breed of windmill will reach higher than any sequoia, and when such blades rotate at even the relatively slow rate of 20 revolutions per minute, the speed of the blade tips approaches 200 miles per hour!

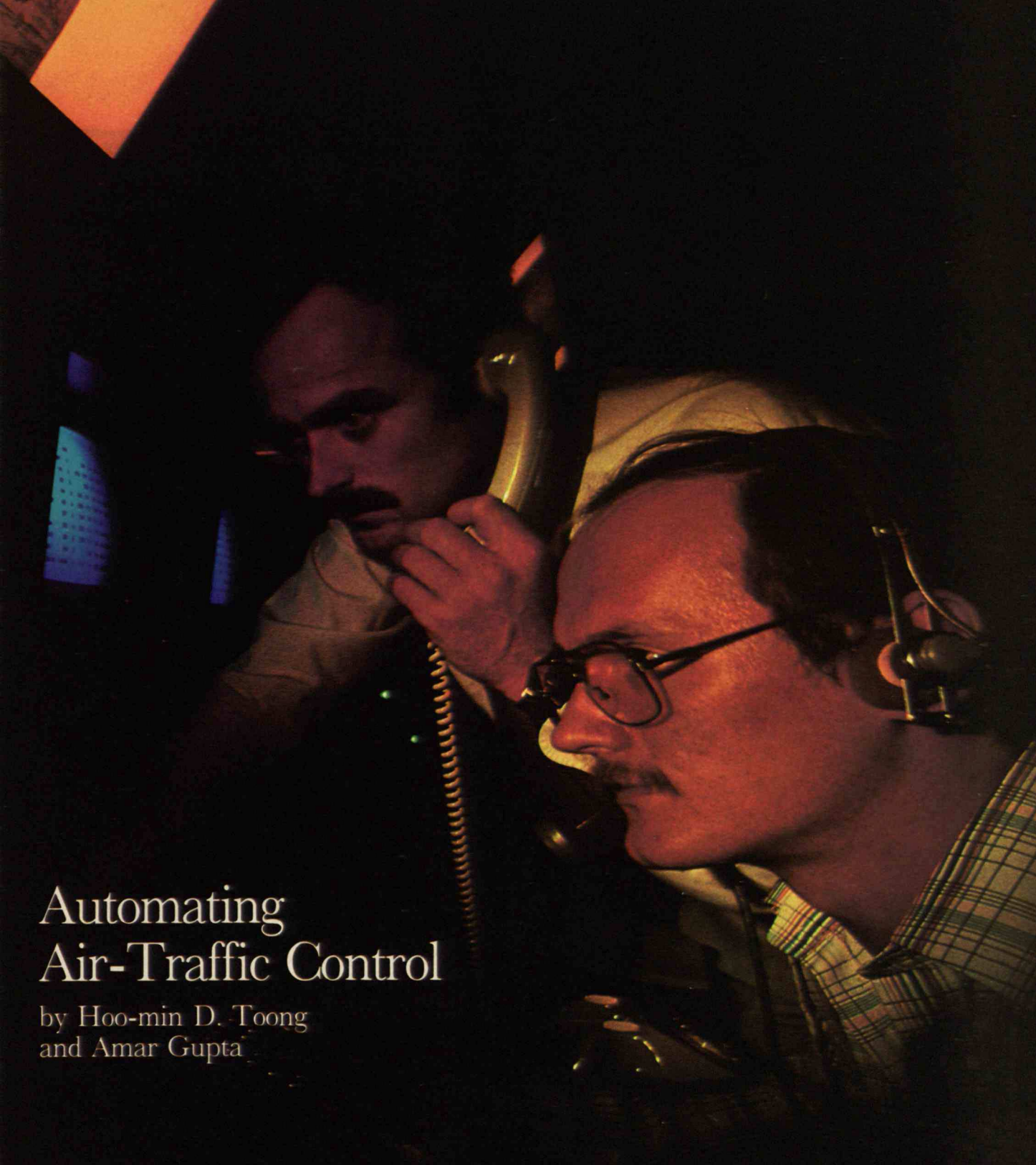
This is a staggering speed, and one can imagine the potential consequences of such a blade breaking over a community of homes it is intended to serve. It would not be unlike an Indianapolis 500 car going out of control into the grandstand. Yet the severe stresses on a massive blade in ever-changing weather are precisely the conditions under which cracks develop and grow and, sometimes, catastrophically sever blade from hub. And even should they not break away, large windmill blades can conceivably pose threats to migrating birds and other flying creatures, interfere with aircraft and radar, prove unsightly in excess, create unacceptable noise, as in Boone, or interfere with television reception, as they have done on Block Island, where another larger windmill presently operates. Thus, the implementation of a soft energy path can affect the environment in ways as complex as those of any coal or nuclear plant, though the individual consequences may not be as great.

Not unlike Oldenburg, who took the common electric fan and magnified its vulnerability in soft vinyl over foam rubber, engineers have been taking steel and concrete and molding the soft concept of wind power into a technology as hard as wide-bodied aircraft and nuclear reactors, and as vulnerable to design flaws. This was to be expected, for a nature trail in our industrialized society can go only so far before it has to cross the hard realities of economics and accountability and development. Perfection comes easy in soft dreams; it comes hard in engineering.

As with our vehicular roads and highways, the soft energy paths will be laid out and maintained eventually under the supervision of engineers, who will learn from today's prototype windmills how to design aerodynamically optimal and structurally sound blades that will withstand not only decades of use but also the vicissitudes of weather and time. The engineers will build large windmills not for their own sake but for the sake of the economy and the society, and the engineers will be both damned and praised for their hard sculptures in concrete and steel, with blades of whatever proves to be the most durable and reliable choice. □

Henry Petroski, a frequent contributor to Technology Review, *is on the faculty of the Civil Engineering Department at Duke University.*

The present U.S. National Airspace System for controlling the nation's air traffic, based on computer technology of the 1960s, is dangerously obsolete. Early this year Administrator J. Lynn Helms of the FAA moved to begin a massive modernization program which will utilize high-speed microcircuits and other new technologies. The government's expanded bargaining power after its successful confrontation with the traffic controllers' union is a factor in Mr. Helms' aggressive advocacy of automation for the future system.



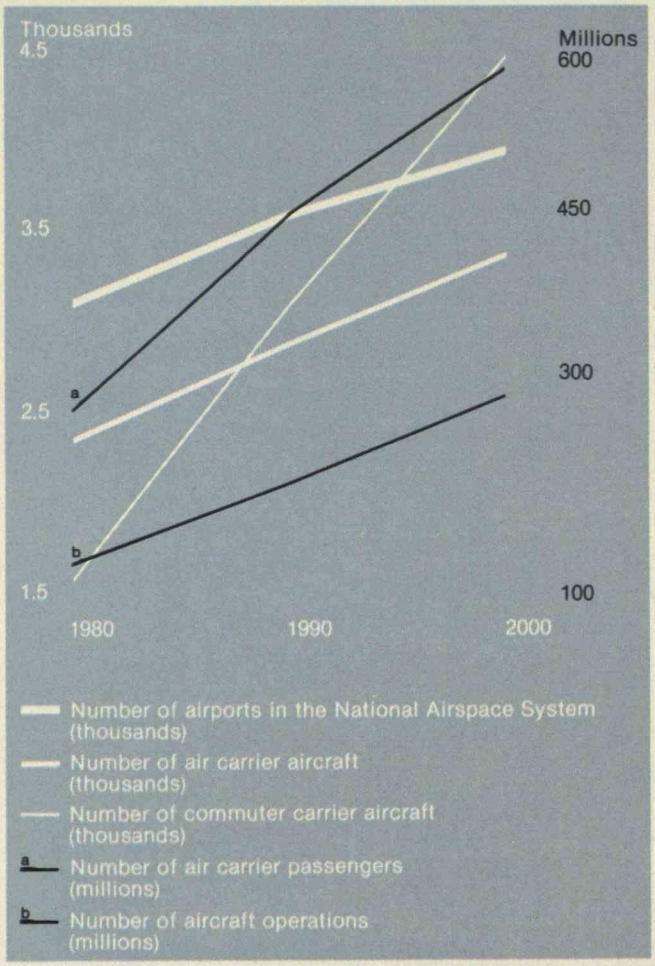
Automating Air-Traffic Control

by Hoo-min D. Toong and Amar Gupta

The government's victory over the controllers sets the stage for a new program to automate today's obsolete air-traffic control system.

THE mid-1981 walkout by air-traffic controllers generated public awareness of a crucial facet of air travel—the 24-hour-a-day effort by the Federal Aviation Administration (FAA) to control aircraft and prevent collisions. The walkout also encouraged government action on a major review and revision of the air-traffic control system in relation to current and future requirements.

Below:
Though the U.S. National Airspace System is already the busiest in the world, forecasts of the Federal Aviation Administration indicate that demands for aviation services will more than double in the next two decades—aircraft operation will be up 116 percent, passengers on domestic air carriers will be up 112 percent, and passengers on commuter airlines will be up 220 percent by the year 2000. Accordingly, the FAA is planning for "a radically new, cost-effective approach to maintaining the nation's airway facilities."



DIAGRAMS: OMNIGRAPHICS

PHOTOGRAPHS COURTESY OF RAYTHEON CO.

The critical factor is response time. Aircraft flying at 600mph ten miles apart could collide in just 30 seconds.

The present air-traffic control system, called the National Airspace System (NAS), was created in the 1960s to provide reliable nationwide air-traffic management through 20 air-route traffic control centers (ARTCCs) across the continental U.S. The NAS fulfills four key functions:

Data collection: assembling information on the position, height, speed, and direction of each plane operating under NAS surveillance over the U.S.

Information processing: calculating airplane trajectories, preferred routings, and collision threats.

Data communication: sharing these data and information among radar sites, control centers, and pilots.

Command and control: decision-making processes in which computers and controllers interact to direct air-traffic movements.

Exercise of these functions involves close and constant interaction among air-route traffic control centers, radar sites, flight services stations, airline offices, control towers, and other locations. The key components include:

Beacon and radar sites where data, including messages originated by aircraft at regular intervals to indicate their identity and altitude, are received.

Radio sites for receiving and transmitting radio signals between aircraft and ground controllers.

Digitizers that convert analog information from beacon and radar sites into digital information for use by computer equipment.

Central computer complexes to handle computations.

Computer display channels to convert data into the formats necessary for controllers' displays.

As the volume of air traffic grows and aircraft fly at ever-increasing speeds, the demands on both controllers and equipment for precise and timely decisions also increase. For example, the computational equipment must have sufficient memory to store the desired information for all aircraft and the capacity to process this information. And it must do this quickly enough to insure that aircraft can be warned of dangers in time to avoid them. This last factor is the critical one: response time degrades first as demands on the system approach capacity, and it is the factor that critically affects safety.

Fortunately, the increase in traffic and aircraft speeds since the current air-traffic control system was put in place have largely been matched by technological advances that could be introduced into all four functions of the NAS. Better and more accurate data-collection equipment, superior information-processing capabilities, and more efficient data-communication systems were available more than a decade ago. Yet the performance and reliability goals established in the early 1960s are simply not being met today, and a major revision of the system will be required during the current decade if needs predicted for the 1990s are to be fulfilled.

Top left:
Will colors added to conventional air-traffic displays help controllers by distinguishing various types of data or alerting them to potential hazards? Tests are thus far inconclusive, suggesting that the nature of the interface between controller and computer is not yet fully understood.

Left:
Twenty air-route traffic control centers such as this one now manage the flow of aircraft between airports throughout the continental U.S. Increased automation included in modernization plans announced by the Federal Aviation Administration will permit eliminating four such centers by 1990 while significantly increasing the capacity of the National Airspace System.

Coast-to-Coast Control

To understand how the elements of the NAS work together, consider a typical scheduled flight. A flight plan that includes the source, route, destination, and key characteristics of the aircraft is filed in advance on the NAS computer system. During takeoff and for a short time thereafter, the plane remains under the control of the airport control tower, which manages the landing and takeoffs of aircraft in the immediate vicinity. (A takeoff may be delayed until the different ARTCCs en route and the destination airport are ready to receive the flight.) When the plane is about 20

The size and complexity of today's obsolete equipment mandate that Murphy's Law applies with a certain frequency.

miles from the airport, one of the ARTCCs become responsible for the control function, and an air-traffic controller assigned to that plane's geographic area assumes the task of monitoring this aircraft, as well as a number of other planes that may be within the assigned area.

The aircraft's location and altitude are picked up at regular intervals by beacon and radar. On the basis of such data, the ARTCC's computer presents moving points on each controller's display screen that accurately reflect the position and progress of each aircraft in the ARTCC's area; each point also carries textual information showing the identity, altitude, and speed of each plane. In addition, the computer projects the path of each plane and gives visual as well as audible alarms if it expects two planes to come too close together. In general, alarms will be issued if planes' lateral spacing will be less than five to ten miles or vertical separation will be less than 1,000 feet, though these parameters vary with factors such as weather conditions and type and speed of aircraft. The controller advises the pilots of necessary changes in direction, altitude, and speed to avoid collisions and to reach their desired destinations.

As each plane moves to the edge of a controller's area, its supervision is transferred to another air-traffic controller, who may be at the same or another ARTCC. When such a transfer is made, the pilot is asked to contact the new air-traffic controller by radio on a different, preassigned frequency. Thus, on a coast-to-coast flight, an aircraft will first be under the control of an airport control tower, then under a series of air-traffic controllers in several different ARTCCs, and finally under the control tower at the airport on the opposite coast. Meanwhile, computers at the different ARTCCs pass along information about the plane as it crosses the boundaries of each control area.

To ensure safety, all computer centers, air-traffic controllers, pilots, radar sites, and radio sites must function accurately and continuously, not only independently but also in conjunction with one another. The operations must be done in what is called "real time": air traffic cannot be halted in mid-air, so the computer system must process data and issue instructions very quickly. Hence, the time constraints on the NAS are increasingly critical as air traffic and aircraft speeds increase. With over 25,000 flights over the U.S. every day, each with its own route, the NAS is today one of the world's most complex real-time operations.

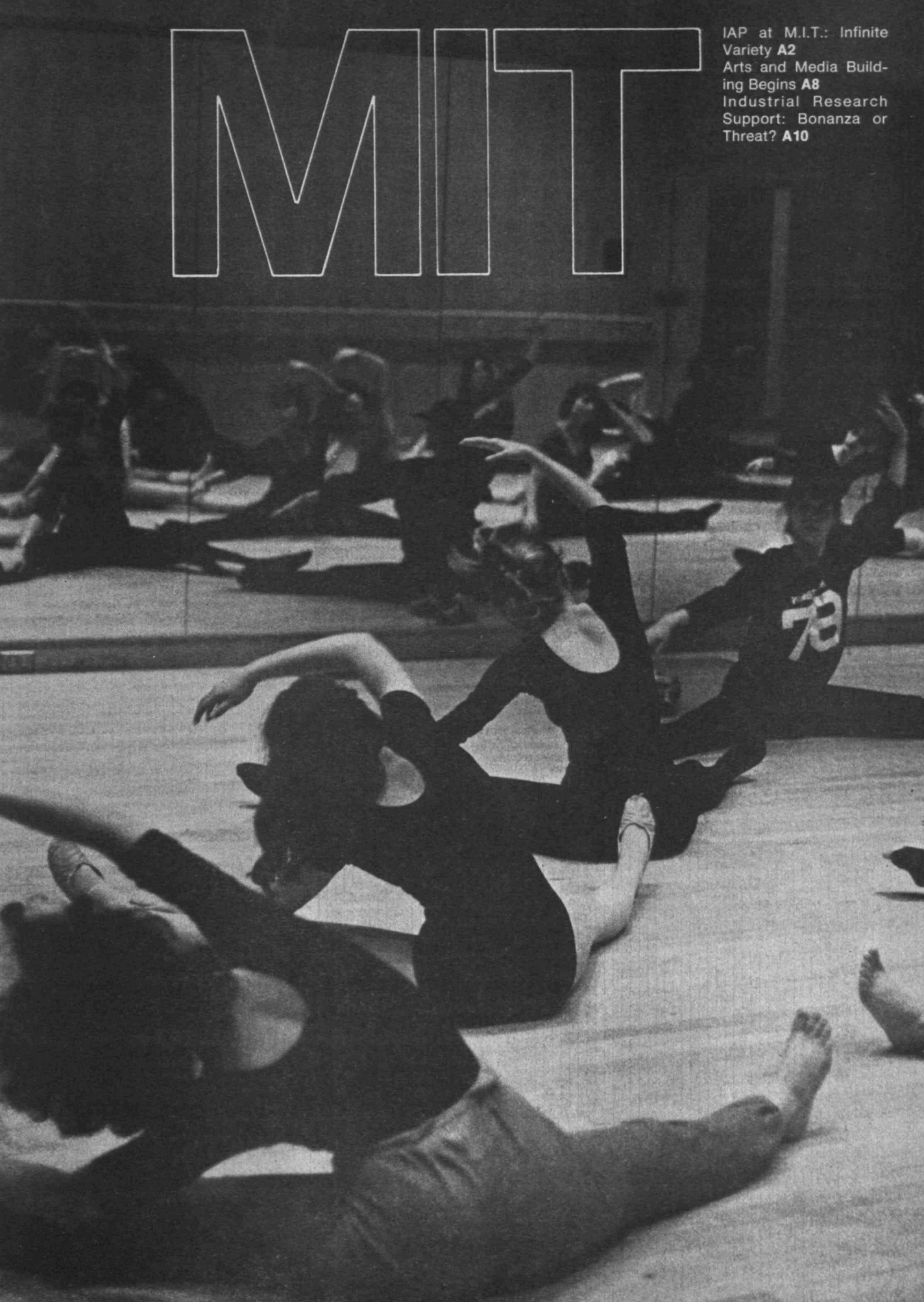
Reaching the Limits of Safety

The 1960s, when the NAS was being designed and implemented, were the days of "mainframe" computers—the bigger the better. But standard computer systems of that time could not achieve the speed and reliability necessary for real-time operation. Therefore, a special computer system (designated the 9020) was designed by IBM. The system incorporated a number of innovations, including an integrated, nationwide computer network with each computer center, having multiple computers, sharing computation with others at different locations—an interconnected system that provides what is called "distributed processing." The system pioneered automatic fault-tolerance, under which redundant elements automatically take over the functions of malfunctioning elements. Thus, the failure of any single element does not affect system performance. Even when two or more elements of a kind malfunction simultaneously, the system continues to function, although with degraded performance.

Communication and coordination among multiple processors is accomplished by a special set of instructions. Millions of dollars have been invested in the development of these instructions. However, the software based on these instructions is now proving to be complex and inefficient, difficult and costly to maintain and enhance.

The size and complexity of today's NAS mandate that "Murphy's Law" applies with a certain regularity. The built-in system redundancies, based on technology innovative during the mid-1960s, are simply not sufficient to prevent random interruptions of service today. Modern aircraft flying at 600 miles per hour on a collision course, with nominal interaircraft spacing of 10 miles, could collide in just 30 seconds. Thus, a computer blackout of even a few minutes' duration could have serious consequences. Therefore, when the computer system "crashes," radar equipment is programmed to bypass the ARTCC computer and transfer its continuous stream of data directly to controllers' display units.

MIT



IAP 1982: New Experiences Everywhere: Cambridge, Washington, Paris . . .

The official academic calendar calls it "a new dimension in educational activities," a period to be "devoted to research, study in a field of the student's interest, travel, relaxation, or investigation of new fields." For at least 3,000 undergraduates, the 1982 Independent Activities Period from January 4 through 27 filled that description fully.

By 10:35 on the morning of January 4 registration was closed for both sections of the Athletics Department's 16-day (one hour a day) squash course. Other classes—swimming, tennis, hockey, figure skating, fencing, you name it—filled quickly.

Meanwhile, at 11 that morning Professor George Boolos, Ph.D.'66, was giving some reassuring advice to 50 students in his class on "The Principle of the Cube": if you can solve the first simple cube—that is, the white face and the immediately adjoining rows below on each side—you are well along to solving Rubik's Cube.

Several other IAP activities also capitalized on this intellectual toy. They culminated in mid-January with a Lobby-7 Rubik's Cube contest, the winner of which—in 39 seconds—was Philip Servita, a senior in Malden (Mass.) High School.

In "Everybody is a Juggler," leader Haj Ross puts his 20 or so jugglers to work almost immediately and within a half-hour, with humor and patience, had them doing the classic three-ball cascade. He advised filling tennis balls with sand or bird seed to retain control of the balls in their hands and to avoid chasing so far after them across the floor when they drop.

Dr. Cheryl Brichett-Pierce taught participants how to develop a perspective on maintaining their health and preventing illness in the first of a four-session course, "Health Promotion, Staying Alive and Well," offered by the Medical Department. She pointed out the irony that people are more conscientious about maintaining the machinery of a computer than they are about the machinery of the human body. She then detailed aspects of proper nutrition.

In the first session of "Ship Model Testing," a course primarily of interest to ocean engineering students, Professor Gary Kavanaugh gave notations for the various types of resistance a ship encounters in a body of water and pointed out those which are relevant in model testing.

A week later students began to discover—and participate in—a room-size laser art installation by Paul Earls, fellow of the Center for Advanced Visual Studies, in the Hayden Gallery.

On January 11, IAP had an unexpected immediacy: Professor Keiiti Aki of the Department of Earth and Planetary Sciences was interrupted during his lecture on the Boston earthquake of 1755 by an aftershock of the New Brunswick earthquake of 1982. Everyone adjourned to the fifth floor of the Green Building to scan seismograph readouts from the George R. Wallace Geophysical Observatory in Westford. Already Professor M. Nafi Toksoz had been actively monitoring the first substantial earthquake to occur since the Wallace Observatory joined the U.S. Seismic Network back in 1975; and four students, free of class responsibilities because of IAP, had gone to New Brunswick with special equipment to be on the scene of likely aftershocks.

Six science writing students attended the annual meeting (Washington) of the American Association for the Advancement of Science, "working" the Press Room with Dr. Barbara Gastel, assistant professor of humanities. And nearly a score of students joined Professor Yosef Sheiffi at the annual meeting of the Transportation Research Board, also in Washington.

Meanwhile, a third IAP group was in Paris—a two-week trip arranged by Jacqueline Hill, instructor in humanities. From headquarters in a Paris youth center, a dozen M.I.T. students explored the city, attended the opera, Comedie Francaise, and the Louvre, and travelled on the new high-speed train to Lyon for visits to two French nuclear plants.

The Civil Engineering Department held a notable seminar series on engineering failure—structural failures, ship losses, dam failures, building failures—which concluded with an effort "to develop a fundamental and comprehensive understanding of the mechanics involved."

Then there was Professor Nesmith Ankeny's one-hour lecture on the history of the theory of poker . . . a seminar on human-powered boats by Professor David Gordon Wilson . . . "reminiscences of a physicist" by Professor Victor Weisskopf . . . six experts on "The Plight of the Auto Industry" . . . Dr. Elaine Li Shiang of the M.I.T. Medical Department on "Medicine in the People's Republic of China" . . .

A Barrage of Delicacies Follow, Plucked from IAP

Be my guest. I'll take your hand and we'll sample the 1982 Independent Activities Period. Like wandering through an amusement park, we'll ride the roller coaster, romp through the fun house, stumble on the unexpected, try this ride or that. At some we may linger, intrigued; at others just a passing glance will suffice.

What to choose?

While we try to decide on a direction, a student stops to talk. "What do you think of I.A.P.?" I ask him. He thinks for a long moment. "There are no set rules—students can become teachers, teachers students," he answers. "Because the traditional structure of classes and quizzes is disbanded, there is a much more recreational attitude about learning. The whole process suddenly takes a different turn: learning can be fun. There is no obligation to be anywhere, no pressure to take a course as a step toward a degree. So everyone is doing things for no other reason than that he or she wants to. Everybody involved is excited."

An exciting time, and off we go . . .

We look into the first classroom tentatively. The topic is interesting yet a little anxiety-producing: "How to find the right job for you." We sit down in the front row.

"We're The Captain of Our Ship"

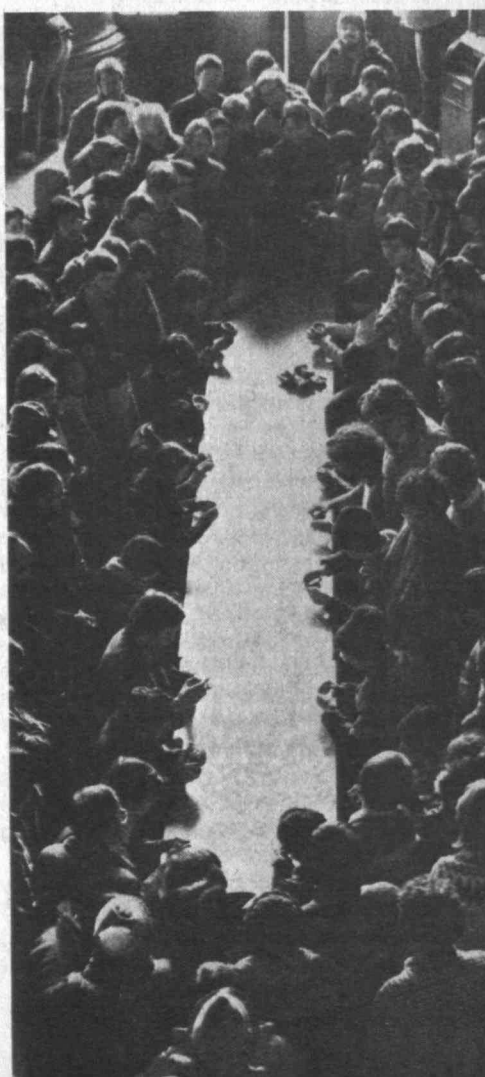
"You are like an amoeba—fluid and ever changing," says Linda Stantial, associate director of Alumni Career Services. "The different parts of you are all interconnected; they are impossible to separate," she tells the group.

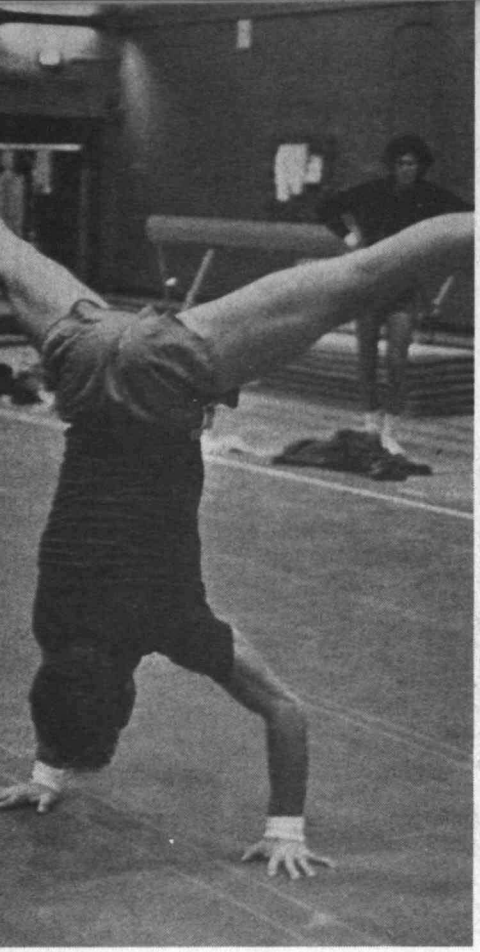
"I want to act as a catalyst today. To make a job change, one needs energy, dedication, patience, and time. I can act as a stimulous. But the individual is the source of the answers to what's right. My role is to help you ask questions," she says.

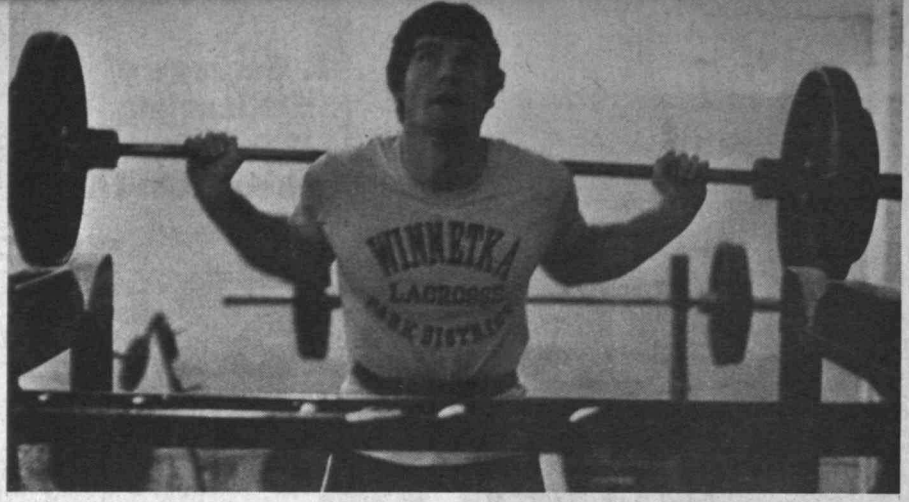
Who you were when you were five is connected to who you were at 15, and 18, and now, she explains, you are an ever-changing entity comprising the whole. Take it all into consideration, and then you can look at what might be your next step.

She suggests we take a journey within ourselves from the past into the present and to the future. We are to draw a "vocational map" on a large piece of paper with brightly colored pens. (I was transported to childhood immediately, always delighted with col-

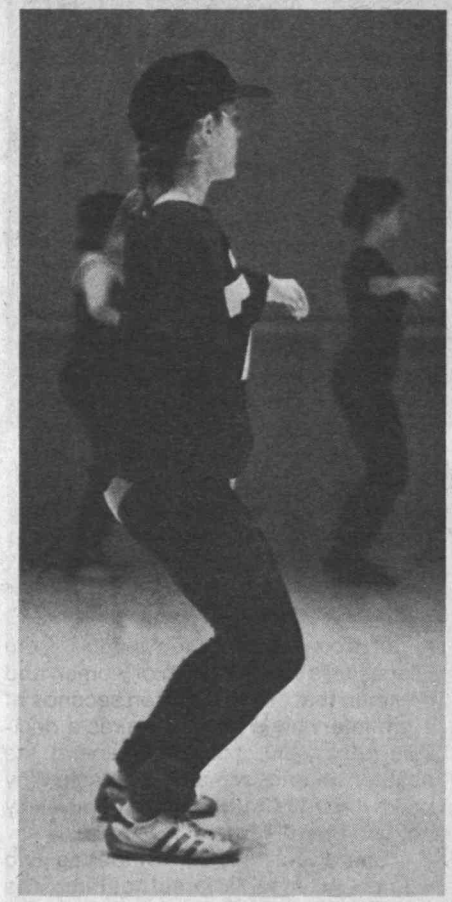
Dance, pottery, newspaper production, a Rubic's cube contest in the lobby of Building 7 were a few events of IAP. (Photos: James J. Snyder, '80)







Sports play a large part in the offered activities during IAP, as well as the arts, building, learning to work with your hands. (Photos: James J. Snyder, '80)



ors and paper.) Trace your life in terms of your work, she suggests. What events, experiences, and people connected with your work influenced your choices of goals in your life?

Think of the concept of crossroads—points at which you had to make a decision. What factors influenced you? Start as a six-year-old and try to include as much as you can remember . . .

We spend 20 minutes engrossed in drawing a map, pulling out of the past superheroes, books, school experiences, hobbies, movies . . .

"Now step back from your map," she tells us. "See if you can draw implications from it. You have been making choices; those influences still matter today. There is a continuity between your choices in the past and those you will make in the future." She suggests keeping a journal, to use writing in the process of making decisions.

The group shares observations. One person notices that all positive points and negative points were tied to people who shaped or influenced her thoughts. For another participant, the feelings and emotions generated by people were *not* weighed when making choices.

Some are torn between seemingly disparate interests, such as music and engineering. Ms. Stantial suggests that such disparities may be more apparent than real; two careers may not be mutually exclusive. Use other people as role models, she suggests: see how other people balance their lives and make their decisions. And focus, too, on your fantasies, she tells us. Don't lose sight of images of what you'd like your life to be. They probably won't be realized in the full-blown ideal, she says. But keep them as a backdrop.

"Often people assume that what they want to do as an avocation can't be turned into a job. Not true. Don't jump to conclusions and compartmentalize. We're the captain of our ship; we can steer it were we want to go."

We decide to stay on the same track, and peek into a discussion of the power of packaging . . .

Clothes Count

A gorgeous well-dressed woman from Filenes tells a large group of women and one man that "in the first ten seconds of a job interview a person makes a decision about you. You might spend the next ten minutes winning him back. Why make it hard? Clothes are your ally; why not use them?"

She shows slides, comparing two women wearing different outfits. The woman on the right will get the job, given that they have equal qualifications, she suggests. It rings true. Clothes may seem trivial and superficial to the idealist, but they count, indeed. Wear a navy blue suit and a white blouse and you will be taken seriously, she says. Not only does the way you dress affect how you will be treated; your outfit at the job interview can even affect your starting salary . . .

Clothes are not all that make the man or woman, though. One's stance in the workplace, manner of communication, posture, eye contact—all combine to create the way you interact with others. And that will determine much of your success in whatever endeavor in the business world you wish to choose. So we now turned to a discussion by Holly Sweet, associate director of the Experimental Study Group (ESG), on assertiveness for managers . . .

Avoid the Repression Stomach Ache

"It is a common misconception to confuse assertiveness and aggression," explains Ms. Sweet. "Being assertive is not about stepping on people's toes. It is a form of direct communication with others where you express your rights and negotiate. The attitude is very important: it includes respect for yourself and for others. Women have problems with being unassertive rather than aggressive. It seems easy for women to respect others, yet hard for them to express their needs and wants," she tells the group. Assertive behavior involves good skills at listening as well as talking.

Why be assertive? Aren't there risks?

The answer is yes: people may confront you, reject you; your position is exposed. But the negative side of *not* being assertive is much more damaging. Some symptoms: the stomach ache caused by unexpressed anger, for instance. The frustration that comes when your needs are unnoticed and passed over.

When to become assertive? Such behavior works when making requests (asking employees to do something); refusing requests (it is important to be clear about when to say no); handling criticism (giving and receiving); and in self-disclosures (letting people know who you are, expressing feelings about a situation).

Certainly it's easiest, says Ms. Sweet, to be unassertive. The unassertive person wants to be liked; the key word is appease. Such a person promises everyone everything, yet ends up with anger from others when he or she doesn't deliver. Because the unassertive person can't criticize effectively there is a tendency to accept and redo substandard work by others—or to say nothing and let it go. Employees lose respect for such unassertive people, and they are prime candidates for manipulation by others.

In contrast, the assertive manager is a good negotiator and communicator. A direct, open manner makes him or her accessible to employees, provides nonjudgmental feedback to workers, and nurtures respect. It's easier to get close to people if you're assertive, says Ms. Sweet. When an employee makes a mistake, the assertive manager finds out why it happened and what to do differently in the future and follows through with constructive feedback. It's important to be specific. ("This is wrong; this is right; this is what should be done in the future.")

How to become assertive? Good eye contact is probably most important, says Ms. Sweet. Maintain firm posture. When having a discussion, be at an equal height (both standing or both sitting). Pay attention to your dress; it is a reflection of what you feel inside. And be aware of voice tone; if it's emotional and quavering, pick another time to discuss the issue.

Timing is important: when do you choose to be assertive? As soon as possible, as long as the moment is appropriate, says Ms. Sweet. Don't let the upset bottle up. But don't criticize someone in front of others.

There was a role-playing session at the end of the lecture in which we had the opportunity to act out the modes of behavior discussed, and we left filled with rules and guidelines. It was time to head for lighter fare . . .

"You're Egging Us on for More Bad Yolks" . . .

ESG (Experimental Study Group) headquarters on the sixth floor of Building 24 has a small living-room-like place that we found jammed with contestants, onlookers, and egger-ons. "Pun Day" is about to begin. The rules: a topic is proposed, and contestants make puns on it. They can say two or three lines with a pun at the end. Extra pun comments and one-liners are welcome. The winner will be chosen by a process of elimination.

Some samples:

Food: That topic is hard to swallow . . . That seems to be a Commons topic . . . It's great to beet you all . . . You keep egging us on for these bad yolks . . . If we have worse jokes, I don't think you will lettuce leaf . . . I don't have any steak in this . . .

Mathematics: I prefer you change to a differential topic . . . This contest is irrational . . .

Medicine: We'll have to be patient with these medical jokes . . . I have a friend at Harvard Medical School who says a thoracic major is easy—all the classes are gut . . .

Books: One of the dorms was receiving two newspapers the *Globe* and the *Times*. Many people didn't like the *Times* (no funnies) so they began to use it for nefarious purposes, like wiping their feet on it when they came in from outside. When asked by one irate *Times* reader what they thought they were doing, they replied, "these are the *Times* that dry men's soles."

Government: The Democrats and Republicans were neck and neck in a close Senatorial race in southern California when a huge mudslide wiped out a section that was heavily Republican. The Democrats won, claiming a landslide victory . . . I think we should skip government and just have a party . . . They are painting the capitol buildings. They painted the cornices and sides, but will paint the ledgeslater . . .

Geography: I'm not well terrained in geography . . . I'm one steppe ahead of you . . . There was a concert where people got trampled in the rush to leave. It was found those who were injured were from a small country in Europe—it was a case of having all your Basques in one exit . . .

Sports: Sports puns? I'll pass.

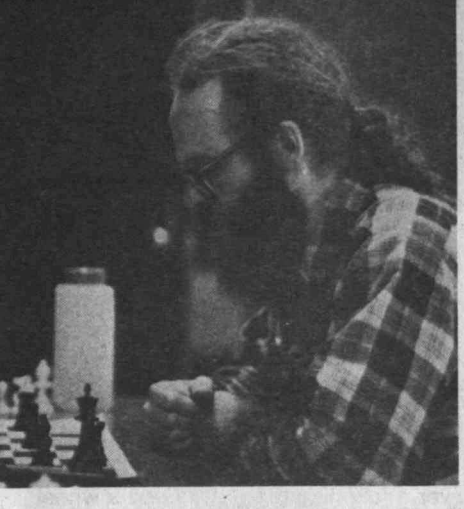
Autos: Datsun other good topic . . . I wanted to be an auto mechanic but you have to wake up oily . . . I could Saab

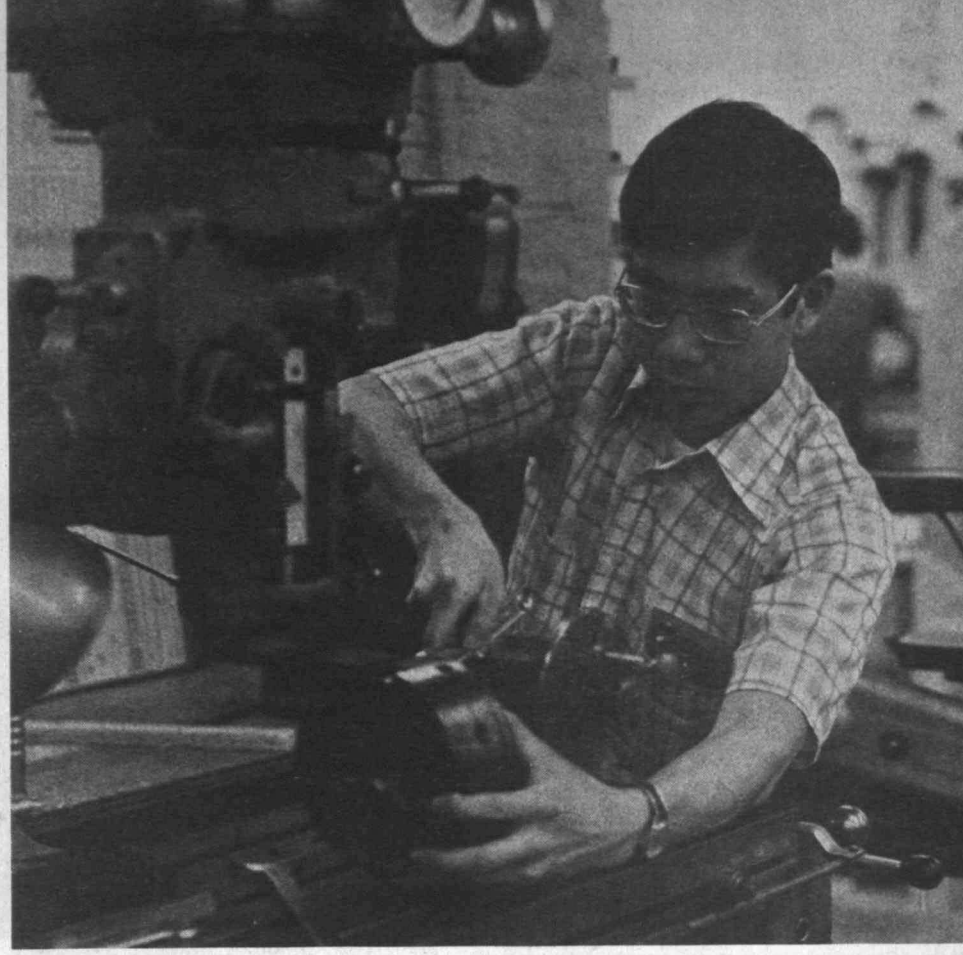
over a joke like that . . . I need a wheel good one . . . A boy scout leader was driving his car on a country road when a cow stopped in front of the car. His horn didn't work, and the cow wouldn't move. He went under the hood and repaired the horn—it was a case of beep repaired . . .

Physics: Some age-old advice: lever or leaver . . .

The winner was Bryan Fortson, '82, a materials student from Washington, D.C. With 15 contestants butchering 15 topics in round-robin fashion, eliminations were made when a contestant could not come up with a pun or make a weak attempt. The show's organizer, Josh Bernoff, a graduate student in math and ESG staff member, made the decisions to keep or throw out contestants (with much help from the boisterous audience, giving thumbs up or down signs and verbal indications of approval or disapproval.) Estimates of the total number of puns: 350

IAP activities included juggling, children's dance, chess, work in the machine shop, and buying bread in Paris. (Photos: James J. Snyder, '80)





"If Not a Pas de Deux, I Can Still Dance"

Still smiling, we venture now into a large lecture hall, a panel seated in the front. The discussion is on an emotional topic: being single. The tone is philosophical, honest, mostly positive, and sometimes anguished. Some anonymous excerpts from panel members and those in the audience:

"In the world of classical ballet, think of the pas de deux: a dance for a man and a woman in a set form. In the beginning, they dance together. Then she leaves and he dances; he leaves, she dances. Finally they again dance together. I would like to look at my life and relationships like that—sometimes we are two together, but at times I exercise my talents freely, and at times he does. There is space for each of us to work as fully functioning professionals. And if it doesn't happen that way, I can still dance."

"Before ten years ago, it was not usual that a woman could support herself. Now women have developed confidence and independence. And it's extremely important that we all assume some level of independence—that we stand on our own two feet. If *that* is your perception of yourself, you'll be better off married *or* single.

"It was only after the break with the third or fourth man that I realized I'd never be on my own, without someone to go home and talk to. Then I found I can live on my own and it is not a problem . . ."

"Through a million kinds of contacts you can fill all kinds of needs. But if you get married you look to one person to fill your needs. I found it very valuable to have the flexibility to change that somebody and job and place.

"To young college women I would offer some advice: Leave yourself wide open to any possibilities. Between the ages of 20 and 30 you will make more changes than you can anticipate. Take in everything; don't be closed to spiritual, emotional, physical, or professional experiences. Women can be enormously generous with men as long as they don't lose their sense of self. There is a need for tenderness . . ."

"People equate single with rootlessness and nothing but a flimsy existence. No—we have roots, values, and a life style . . ."

"I have lived with my boyfriend for four years. We are not married and don't want to get married. Yet I'm living as more married than many married couples. But it's uncomfortable for me to feel married. I don't buy 'forever.' I want to grow and change."

"I noticed at a family gathering that was mostly married couples, that the context of their discussion seemed not so much supporting each other but supporting their possessions . . ."

"You sound like it's so easy. I find it difficult to be unattached. How can I resolve these difficulties?"

"I'll answer that. There are times of intense personal loneliness; you can't escape them. But that hasn't killed any of us. We do not need to fill life with surrogate enthusiasms . . ."

"Our psyche has a need to be intimate. Most of us term it 'being married.' That's not necessarily the answer. Knowing that you are completely alone is a very important lesson. Relationships can grow healthier after that."

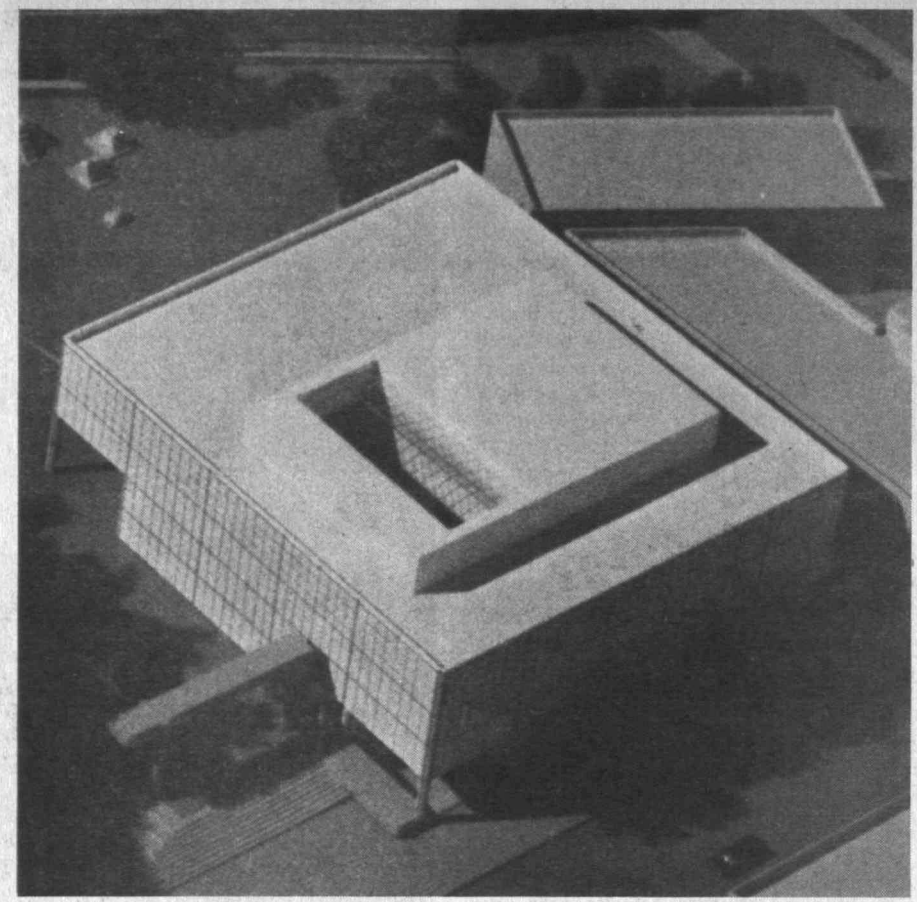
"Some problems associated with being single are really just problems of living. You have to come to terms with yourself."

"Marriage was a license to let other people into our relationship—and unleashed a great deal of socialization. Suddenly people knew how to treat me—if the house was dusty, it was my fault, not his. I'm supposed to do dishes. My mother-in-law was much closer—she could relate to me in a different way. Suddenly everyone knew how to treat me. That is an important consideration when you sign that paper . . ."

"The negative impression of single is formed when we are young and impressionable . . ."

And from a man: " 'Old maid' is an image confined to women. But the feeling is not; yet there seems to be no equivalent word for a man . . ."

On that note, we head for Building Seven Lobby. There we find strange creatures, some looming over us six feet tall at the top. One huge head supports a grotesque nose, paper mache ears, and red rouged cheecks. Others are clad in red, black, and orange costumes. We are delighted by a show of puppets. Far to one side, we spot a bright yellow sun face, a round fat disc about one and one-half feet across. Our feet, a little weary, are nevertheless irresistably drawn down the hall where a big sign points to Puppet Workshop . . .



Melding Art and Communications in Concrete: The Arts and Media Building Begins

The model shows the site and shape of the arts and media technology building now under construction, and the photograph shows the three principals in its conception and design: I.M. Pei, '40 (left), the architect whose personal commitment to the field has helped shape both concept and building; Vernon Alden, chairman of the Council for the Arts' Facilities Sponsoring Committee; and President Emeritus Jerome B. Wiesner (right), chairman of the Council for the Arts, whose concern for bringing the arts into a partnership with technology on the M.I.T. campus has been a major motivation.

Construction has begun on a new East Campus building for M.I.T.'s growing programs in the arts and media technology, with completion scheduled for the spring of 1984.

The total project cost is $25 million, including $16 million for the building itself and $9 million for land expenses, design, utilities, and a ten-year maintenance fund. A total of $18 million is now available for the project, and fund-raising is continuing to secure the balance needed.

President Emeritus Jerome B. Wiesner, who is actively involved in the project as chairman of the Council for the Arts at M.I.T., says the new building will be a "world center" in those fields which link technology, communications, and aesthetics; he promises that it will bring "a new dimension of human creativity to M.I.T." Howard W. Johnson, chairman of the Corporation, says the project "affirms again M.I.T.'s dedication to research and teaching at the frontiers of information technologies."

A building for such apparently disparate fields as art and technology has posed a special challenge to architects as well as would-be occupants for at least a decade. Dr. Wiesner, who has been committed to the project for at least a decade, described the evolution of the building to members of the Council for the Arts in November, 1979: "In the beginning it looked pretty simple. We had a number of rather clear-cut needs," he said—better workspaces for artists, better housing for the film/video program, more space for visual communications.

But when these groups came together to make plans, a new kind of "dynamic interaction" began to assert itself. The members of the video group, the film group, the computer music group, and others saw that they had things in common, and that led to a "rather sudden emergence of a collaborative program that we hadn't expected," Dr. Wiesner said.

"Over a period of nine months," Dr. Wiesner told the council members, "we went from a rather static concept of the original plan in the disciplinary mode to spaces that allowed people and programs to interact dynamically. I used to think we could never converge on this building unless we learned how to live in 15-dimensional space, because everyone needed to be near everyone else."

Apparently the architect, I.M. Pei, '40, had as much trouble with this problem at first as everyone else, Dr. Wiesner said. But perhaps because of Mr. Pei's own experience as a member of the Council for the Arts and his highly developed interest in the arts in relation to technology, he has been successful in resolving the dilemma. "What we now foresee," Mr. Pei says, "are many spaces designed to be shared—to be

used for interactive programs, common work and teaching spaces, common display spaces, areas for common public and private needs." Speaking to members of the Corporation in 1980, Mr. Pei described his vision for the new project: ". . . more a laboratory than a museum . . . the most exciting building in which I have ever been engaged."

The new structure, across Ames Street from the Landau (chemical engineering) Building, will link the traditional main campus of M.I.T. with the newly developing east campus, dominated by the Whitaker health science complex which was dedicated early in March. It will contain 110,000 square feet of space—classrooms, exhibition spaces, an experimental theater, and laboratories for advanced information delivery and display systems, computer graphics and animation, computational video, man-machine systems, consumer electronics, experimental print media, photography, holography, film/video, electronic music, and computers in education.

To student groups who found themselves outside instead of inside the new building—Dramashop, the Shakespeare Ensemble, and other performing groups—Peter Spackman, executive director of the Council for the Arts, explained: the new facility is not intended to be an all-embracing arts center. Its goal is to couple M.I.T.'s interests in visual arts with those in advanced communications technologies.

Vernon Alden, former president of Ohio University, Athens, Ohio, who is now a business, civic, and cultural figure in the Boston area, heads the Facilities Sponsoring Committee of the Council for the Arts and therefore has major responsibilies to complete the building's funding. "We have compartmentalized ourselves in every aspect of our lives," he says in explaining his own commitment to the project—a division of labor that has "cut us off from our roots. [This project] is not simply a matter of reordering priorities," he has told fellow-members of the council; "it calls for rediscovery of the colleagueship of separate talents which has been mislaid in the rush to the specialization of human effort." The real issue, he says, is a building which will help "reintegrate the arts into our common experience."

Succumbing to Selective Hindsight

by Stephanie Pollack, '82

Try the following experiment:

Take a recent high school graduate, probably male, 16 to 19 years of age. Place in an open field, inject with greasy chicken or roast beef, and after a couple of speeches, expose to hordes of rushing upperclassmen. Leave unattended for one week, then force to make critical decisions on housing and courses with little or no guidance.

Provide dull classes and a challenging bureaucracy. Extract large sums of money at frequent intervals. Solicit opinions and blatantly ignore them. Limit social interactions to the minimum neccesary for survival, if not slightly less. Continue for about four years.

Expected result is not a contented alumnus. While somewhat exaggerated, the preceding scenario represents the perceptions of quite a few M.I.T. students. The Institute seemingly puts little effort into insuring that students leave with a lasting affection for the school. Throwing in a free dinner during spring term senior year hardly appeases most graduates. For some reason, however, some students leave M.I.T. and become loyal alumni, contributing regularly to the Institute both financially and personally.

The number of active alumni has not changed much over the years. The 1979-80 Alumni Association report shows that participation in class reunions and Alumni Officers' Conferences has remained fairly steady over the past five years. Membership in alumni clubs has leveled off after growing during the mid-1970s. The Alumni Fund received a record amount of money from a record number of contributors in 1979-80.

Not everyone succumbs to the Institute's well-disguised charms, of course. While the statistic that 23,600 alumni made donations to M.I.T. in 1979-80 is an impressive one, the figure represents less than one-third of the 71,800 alumni alive at the time. Still, any positive response is surprising given M.I.T.s almost nonexistent efforts at promoting loyalty and affection.

So why do many graduates come back for Technology Day to see people they barely socialized with as students? I'm not sure. Neither do I understand why people donate to the Institute even while paying off student loans, or why they become educational counselors and encourage others to come to M.I.T. I cannot fathom the reasons others would do such things; I can't even really decide why I will. I know, however, that I will do so.

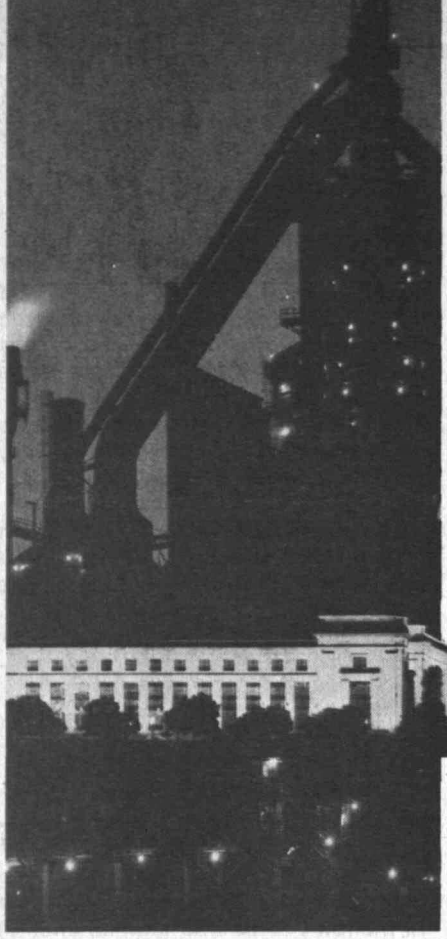
I am not yet an alumna of M.I.T., but expect to become one in June. I realized last term that I wanted to remain active in Institute affairs after graduation. So like the others, I will trek back for reunions and expend some of my meager government salary to get a subscription to *Technology Review*. Perhaps I will become an educational counselor.

The only justification for this sudden sentimentality has to be selective hindsight. With graduation in sight, the memories of an unyielding, uncaring bureaucracy are superseded by those of the few people who took an interest in me. The drone of the uninterested professor and the babble of the foreign teaching assistant are drowned out by the sounds of an exciting class discussion. The tedium of problem sets fades while the satisfaction of successfully mastering a test question lingers.

Praising the Institute is hardly fashionable and not particularly easy. Flaws are always easier to spot than strengths; problems are always present while good points appear only in retrospect.

Despite all of its inadequacies, however, M.I.T. somehow provided me with an environment in which I could grow and learn. I am not the same person I was three and one-half years ago, and M.I.T. must be given some share of the credit for whatever improvement has occured. The Institute is an unparalleled gathering of intellect, both proven and potential. Failing to benefit from exposure to such an environment cannot be blamed solely on M.I.T.

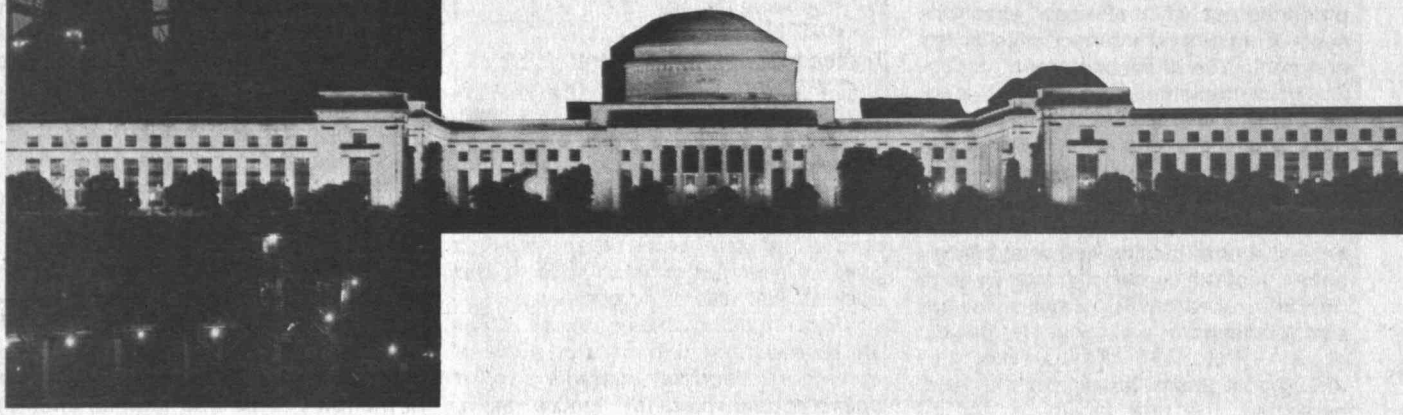
My newly-discovered ability to recall the bright side of the Institute has not impaired my ability to see its weaknesses. I will be graduated from one of the finest technical schools in the country, yet I am leaving an institution in need of improvement. A desire to return the favor and help M.I.T. better itself is, perhaps, the reason I will remain involved.



". . . significant cooperative efforts between the universities and the industrial sector will be even more important to the advancement of education, knowledge, and industrial progress in the future than they have been in the past."—President Paul E. Gray, '54, at the Technology Northwest Symposium, January, 1982.

A New Groundswell of Industrial Research Support:

Bonanza or Threat?



Industrial support for research at M.I.T. has doubled in dollar value during the past two years, and Howard W. Johnson, chairman of the M.I.T. Corporation, cheerfully cites many observers who believe that "a reinvigorated university-industry relationship will be the wave of the future."

Indeed, says Edward E. David, Jr., Sc.D.'50, president of Exxon Research and Engineering Co., "the pressures pulling . . . industry and the university together are inexorable and fundamental." He expects within a decade to see "a vigorous community of industrial-academic scientists, with its academic members enriching industrial research and industrial organizations providing the link to commercialization."

President Paul E. Gray, '54, agrees. "My own view," he told the Technology Northwest Symposium of the M.I.T. Club of Puget Sound during the winter, "is that significant cooperative efforts between the universities and the industrial sector will be even more important to the advancement of education, knowledge, and industrial progress in the years ahead than they have been in the past."

$450,000 from IBM

An example of the trend is a new $450,000 grant extending for five years an eight-year-old collaboration between M.I.T. and IBM in computer science and technology, announced last year.

Professor Michael Dertouzos, director of the Laboratory for Computer Science, describes the IBM-M.I.T. relationship as "long and fruitful." The large size of the grant, together with the freedom which IBM gives to M.I.T. in its disposition, mean that "we have often been able to fund projects that might be unpopular with traditional funding sources becase they are so novel," Professor Dertouzos explains.

For other reasons, too, says President Gray, the collaboration has yielded results hard to reach in other ways. "Because IBM and M.I.T. are both prominent in their domains, the progress we have made has high visibility and moves quickly through the electronic research community," he explains.

There is enthusiasm for the collaboration from IBM's side, too. Lewis M. Branscomb, IBM vice-president and chief scientist, is pleased to provide "flexible funding that encourages new scientific initiatives and minimizes red tape," and he likes the arrangements which are in place for IBM scientists to collaborate with M.I.T. on topics of mutual interest. The Institute's "special intellectual and creative environment compels IBM to help ensure that M.I.T.'s computer science research stays strong," says B.O. Evans, IBM vice-president for engineering and technology.

The IBM-M.I.T. collaboration began in 1973, under an agreement which allows the Institute to allocate one-third of the funds at its complete discretion while using two-thirds for projects in which the sponsor has expressed its interest. IBM receives non-exclusive licenses on patents and copyrights resulting from work supported by its funds.

Using the Universities?

But even as both sides of one such agreement were extolling the virtues of university-industrial partnerships, Professor David F. Noble of the M.I.T. Program in Science, Technology, and Society was raising an alarm: as universities across the U.S. are increasing their connections with private industry, Professor Noble wrote in the *Los Angeles Times* late last fall, "corporate officials are attempting to use the credibility of academic institutions to legitimize their messages."

Because many participants conceal the monetary arrangements which are involved, Professor Noble says, this growing university-industry collaboration may risk "undermining the public trust in the universities that makes academic freedom possible."

The $8 million cooperative research agreement between Exxon and M.I.T. announced in 1981 seems to Professor Noble an example—"a continuation of a long petrochemical industry quest for academic support of its goals, an effort to co-opt the experts'," he wrote last fall in *The Link*, an M.I.T. alternative newspaper.

Energy Laboratory authorities are more bemused than disturbed by Professor Noble's concerns. Exxon's claim on the laboratory's results is the same as that given to IBM by the computer science collaboration—a non-exclusive royalty-free license to all patents, with some financial return possible in addition. And the Energy Laboratory is happy enough, it says, to know what jobs seem from Exxon's perspective in the energy field to be most critical.

The increasing industrial commitments will at once be supported by and the cause of a growing trend toward "closer coupling to real world problems" on the part of engineering education, says President Gray. "It is clear," he said at the Pacific Northwest conference, "that the center of gravity of engineering research is moving toward societal needs."

A Threat to Basic Research

But therein lies yet another threat, says Jonathan King, professor of biology who is a leader in the new field of genetic technology. For he fears a "distortion" of basic biomedical research by commercial interests intent on exploiting genetic engineering for corporate gain.

"The commercialization of research focuses on the production of products for sale," Professor King told a press conference during the 1982 annual meeting of the American Association for the Advancement of Science in Washington. "It distorts priorities, biases research, and biases individuals in the field into shaping research" toward potential profit centers. For example, he said, genetic researchers will become more interested in finding ways to produce different types of insulin than in curing diabetes. So Professor King argues for continued government commitments to basic research: "If the National Institutes of Health should walk out of basic research," he said at the AAAS meeting, "we're not going to have many things we need, because they're not commercially viable."

Mr. Johnson perceives that threat, too. "I believe it is imperative that we maintain the health of our basic research," he told the annual dinner of the New England Council late last year, "(for it is) basic research that undergirds our technology."—*J.M.*

Alumni Election for the National Selection Committee

Ballots are due by May 15 in the 1982 Alumni Association national election. At stake are three seats (three-year terms on the National Selection Committee, whose duties are to choose national officers of the Alumni Association and to nominate alumni members (five-year terms) of the M.I.T. Corporation. The ballot is inserted at the right, and the nominees—one from each of the three districts is to be elected—are listed below.

District 1
Boston Postal District

Susan L. Kannenberg
S.B. 1961, Physics
Energy Analyst and Program Manager
Northern Energy Corp., Cambridge, Mass.

Educational Council: Member, 1980—

Alumni Council: Member, 1976—

Association of M.I.T. Alumnae: Executive Board, 1965-75; President, 1976-80.

Alumni Activities Board: Member, 1979-82.

Member of the Ellen Swallow Richards Professorship Committee, 1976—; Chairman of the Alumnae Survey Committee, 1972-73; founder of the Alumnae High School Visiting Program, 1979; telethon solicitor, 1979-80.

Governor's appointee to the Special Legislative Committee to Study Protective Laws, 1973

Member: Sigma Xi, AAAS.

David S. Prerau
S.M. 1966, Ph.D. 1970, Electrical Engineering
Senior Research Engineer
GTE Laboratories, Inc., Waltham, Mass.

Alumni Council: Member, 1980-82.

M.I.T. Club of Boston: Board of Directors; 1974-76; Secretary, 1975-76; Executive Committee, 1977-79; President, 1976-77 and 1981—; Vice-President, 1980; Chairman, West Suburban Regional Board, 1982.

American Federation of Information Processing Societies Award.

Member: Sigma Xi, Tau Beta Pi, Eta Kappa Nu, IEEE

Carl H. Wilson
S.B. 1934, Management
Retired; former Managing Director of Foster-Grant-Europe, London.

Alumni Council: Member, 1961-75; 1978-79.

Alumni Day Committee: Member, 1972-73.

SCF: Solicitor, 1961-63.

Class of 1934: 20th, 45th, and 50th Reunion Chairman; 50th Reunion Assistant Gifts Chairman.

Boston Stein Club: Director, 1975-80; Vice-President, 1976-80; President, 1980-82.

District 2
Northern New England

Charles G. Beaudette
S.B. 1952, Electrical Engineering
Principal, Cape Associates; Technical consultant and project manager, Chapman Corp., Cumberland, Maine.

M.I.T. Club of Western Maine: Member, 1965—

IEEE Communications Society: Vice-President, Maine Chapter, 1976-77.

Pan American Society of New England: Member.

Bernard H. Nelson
S.B. 1935, Civil Engineering
Retired (South Harwich, Mass.); former Assistant Vice-President, New York Telephone Co.

Bronze Beaver Award, 1978.

Alumni Council: Member, 1977-78; Life Member, 1978—

Educational Council: Member, 1954-64.

Class of 1935: President, 1975-85; 45th Reunion Chairman.

M.I.T. Club of New York: Vice-President, 1952-55; President, 1956-57.

M.I.T. Alumni Center of New York: Honorary Secretary, 1964; Director, 1965-74.

M.I.T. Club of Long Island: Director, 1970-72.

M.I.T. Club of Cape Cod: President, 1976-78; Director, 1978-80.

Awards Committee: 1980-83

Boy Scouts of America: Silver Beaver Award, 1965; Greater New York Council Executive Board, 1959-74; Brooklyn Council President, 1959-60.

Chief Signal Officer, U.S. Army African-Middle East Theater, 1945-46; U.S. Legion of Merit, 1946.

Stanley A. Wulf
S.B. 1965, Mechanical Engineering
Amps Limited, Mattapoisett, Mass.

Alumni Council: Member, 1978—

M.I.T. Club of New Bedford: Vice-President, 1977-79; President, 1979-82.

Alumni Fund: Telethon solicitor, Chicago, 1970-71; regional gifts solicitor, New Bedford, 1977-78.

Cape Cod Toastmasters' Club: past president.

District 4
New York, Long Island, & New Jersey

Philip A. Falcone
S.B. 1966, Civil Engineering
Principal and Vice-President, Paulus, Sokolowski & Sartor (consulting engineers), Westfield, N.J.

Alumni Fund: Regional gifts chairman, 1975-79.

M.I.T. Alumni Center New York: Director, 1978-80.

M.I.T. Club of Northern New Jersey: Director, 1975-76, 1980-82; Vice-President for Programs, 1976-78; President, 1978-80.

Member: American Consulting Engineers Council, ASCE, NSPE, NJSPE, AIPE, Tau Beta Pi, Chi Epsilon, Theta Tau.

Advisor in civil engineering technology, Union County (N.J.) Technical Institute.

Leonard F. Newton
S.B. 1949, Management
Consultant in communications and energy, Princeton, N.J.; formerly Vice-President, Response Analysis Corp.

Alumni Association: Director, 1970-73.

Technology Review Advisory Board, 1971-73.

Alumni Fund Board, 1967-69.

Class of 1949: Class Agent, 1974-79; 25th Reunion Gifts Chairman.

M.I.T. Leadership Campaign special gifts solicitor, 1975-80.

M.I.T. Alumni Center of New York: Director, 1977—.

M.I.T. Club of Princeton: founding President, 1976-77

Long-Range-Planning Task Force, 1965; Alumni Officers' Conference Committee, 1971-74.

Jack Solomon
S.B. 1963, Chemistry
Process Manager, Market Development (industrial gases in steel, chemical, and electronics), Union Carbide Corp., Tarrytown, N.Y.

Educational Council: member, 1979—.

M.I.T. Club of Westchester: Director, 1979—; Treasurer, 1981—.

Alumni Fund: regional gifts solicitor, 1977-78.

Member: AIChE, ACS, Sigma Xi, ISHM.

Classes

05

A letter from **William Spaulding**, 520 Kenosha Ave., Norfolk, VA 23509, dated December 14, 1981, says: "I'm still alive and living with my daughter—though going very slowly and cautiously. Keep up the good work."

Your secretary is still getting around in spite of lameness. He enjoys stereo music, books, and his friends. We still welcome and hope to hear from '05 classmates.—**Gilbert S. Tower**, Secretary, 35 North Main St., Cohasset, MA 02025

13

Charles Albert Smith writes: "I am 93 in good health. My mining activity at present is digging for gophers in my backyard. Physical activities are somewhat limited, and my driver's license says 'no no' to night driving (otherwise no limitation). My wife (87) is active as can be. Neither of us have ever resorted to a cane or other walking aids." . . . **Walter P. Muther**, class president, says, "I am still a limited 'gentleman farmer': walking behind a self-propelled rototiller, I hang on. Presto! I walk—so essential to my well-being! I also raise good fresh vegetables. 'Elephant garlic' is my specialty." . . . We received a card from **Ken Blake**'s wife, Hazel, stating that Ken's eyesight is still bad, but otherwise he is in good health.

Allen F. Brewer keeps active and is still writing poems which are published in the Jensen Beach newspaper, *The Mirror*. He writes: "We hope 1982 will treat us all most kindly. We have bypassed any serious physical ailments; except for arthritic pains and emphysema, we function acceptably well for our ages. No complaints. Living so close to the coastline, we are concerned about the inroads of tides and winds on our beaches. The latest storm raised havoc on some parts of the Hutchinson Island beaches. Factors of safety, as we were taught at Tech, are wonderful precautions, but the ocean has no regard for technicalities. Nor do the developers, either.

"We now have a Ph.D. in the family. My granddaughter, Krista Bomer, received her doctorate in linguistics from the University of Pittsburgh last year, specializing in Spanish and Russian languages. Presently she is teaching at Ohio State University in Columbus. Marine and I are both looking forward to my reunion in 1983. If the good Lord is willing, we will be seeing you then." Here follows Allen's poem on saving the barrier islands:

A barrier is an obstacle for defense
and protection,
Of human frailties in peace and
war.
But Nature also forms a barrier 'gainst
tide and wind erosion,
When waves go on a rampage from upheavals
in the ocean.
We call these barrier islands along our
coastal shores.
But they can't be infallible, nor work
for evermore.
So sand dunes and sea oat roots have
flourished through the years,
To fortify the barrier so the sand
won't disappear.
It's Nature's type of bulwark for the
shoreline 'gainst the storm.
The tides may wash the sand away,
later, new deposits form.
To some extent it's feasible to lend
preventive "hands,"
By bulkheads, jetties, man-made reefs
To control the vagrant sands.
But even these could fail if sand dune structu
be disturbed;
The dunes are nature's last rest when the
wild waves must be curbed.

Anyone living on any coastline—Florida to Maine or the West Coast—should be concerned about preserving our dunes, wetlands and marshlands.—**Rosalind R. Capen**, Assistant Secretary and Treasurer, 7 Brackett Point Rd., Biddeford, ME

14

Word came in December of the death of **Egbert C. Hadley** in Middlebury, Vt., on September 25, 1981, at the age of 92. After graduating from Middlebury College, Phi Beta Kappa, in 1910, he was our classmate for all four years and received his S.B. in Course VI. After a year of military service, he joined Remington Arms Co. in Bridgeport, Conn., as a ballistics engineer. He remained with that company as a technical director, executive, and administrator in several key posts until his retirement in 1948, when he moved to Middlebury.

Bert was a member of the M.I.T. Corporation from 1940 to 1945. he was president of the Sporting Arms and Ammunition Manufacturers Institute from 1953 to 1974 and later was honorary chairman of its board. He also was a director of the Naitonal Bank of Middlebury and chairman of the Wildlife Management Institute in that town. Burt was elected a trustee of Middlebury College in 1936 and, as the fifth member of his family to hold that office, continued a family association with the college that went back to 1806. He became chairman of the trustees in 1944 and remained in that post until his retirement from the board in 1968, when Middlebury made him an honorary doctor of laws. Bert also received an honorary doctor of engineering from Norwich University in 1949.

In 1917 he married the former Marjorie Finch. They had a son, Egbert Starr Hadley, born in 1919, but neither his wife nor his son survived Bert.—**Charles H. Chatfield**, Secretary, 177 Steele Rd., West Hartford, CT 06119

16

We had a nice note from **Henry Shepard** relative to our 65th Reunion: "It was a most enjoyable occasion. Thanks a lot for your efforts in staging the whole affair." . . . Also from **Chet Richardson** on the 65th: "The service and general atmosphere of M.I.T.'s Endicott House was absolutely tops. We both thought the whole reunion experience was 100 percent enjoyable, the highpoint of the year. My older daughter, Ruth, (an expert on birthdays) reminds me that November 24, 1895, was an important day in your life! Realizing that this letter will arrive after the fact, we hope that you had a very pleasant day commemorating the 86th anniversary of that noteworthy event." Chet's daughter, Jane, wrote of the reunion: "It was truly an unforgettable experience and one that we will cherish. The most stimulating challenge before us now is to figure out how we can attend the next reunion and participate in all that fellowship, which is the very essence of the whole affair. If we conquer that challenge, you'll see us next year!"

Hildegarde Carr with whom we had lunch in Palm Beach, Fla., last December writes: "Was so nice to see you both. Hope you got home safely." . . . Mildred and **Charles Reed** sent a nice Christmas card.

Gerstle Mack sent along a tribute to John Staub, '15, who died last April. (We have passed this along to the *Review*.) In his covering letter, Gerstle writes: "I know it is customary for former classmates, even if they have never met each other, to use first names; but I have been out of touch with M.I.T. for so many years that I would find it difficult to summon up enough school spirit to call you 'Dear Ralph' without self-consciousness. So please please forgive the formality of 'Mr'. The noses of our little group of ten were kept so closely to the grindstone, every day and many evenings, that we had no time for social activities or student affairs. That was not so true of John Staub, who did have two years of undergraduate life at M.I.T. and more opportunity to mix with the general student body. I, having graduated from the University of California at Berkeley, spent only that one post-graduate year at M.I.T."

Finally, we regret to report the passing on November 6, 1981 of our classmate and good friend, **George D. "Jack" Camp**. May he rest in peace. . . . Keep eating, drinking, walking, breathing, everything in moderation, and yes, of course, keep writing.—**Ralph A. Fletcher**, Acting Secretary, P.O. Box 71, West Chelmsford, MA 01863

17

Here is the nitty-gritty of the beginning of sailing at M.I.T., thanks to Herbert Polleys, '18. "**Jack Wood** and I grew up together in Providence, and we sailed on Narragansett Bay. At Tech I became the co-owner of a small boat *Wampus* which Jack acquired and deposited in the back yard of 484 Beacon St., our S.A.E. house. I helped him paint and condition her and eventually slid the boat through the back gate and into the Charles. *Wampus* was the start of his eventual career. I bought him out and shipped the boat back to Bristol, R.I. We sailed the *Wampus* all over the basin and taught some of the brothers the know-how. On occasion Jack was known to carry the rudder to class to assure *Wampus* safety."

Penn Brooks contributes, from his Virginia farm home, a chatty run down of some of his activities. "Year 1981 was a good year all in all. I did not break any bones nor did I have any hospital bills. After the holiday season, I occupied for six weeks the same old cottage I have rented before on San-

ibel Island, Fla. It is vintage 1900, on the beach, and large enough to accommodate many of my family at one time. Got in lots of fishing and beach walks but I left the abundant shelling to others. In the spring I spent a week in Italy, getting to Florence for the first time. The late spring and most of the summer I was here at the farm, looking at the cows, geese, and horses. I spent a week in Alaska salmon fishing but with no success. The wilderness and primitiveness of Alaska is always appealing. This fall was spent here, getting acquainted with the livestock. My son Bob and his family live in Richmond, so I see them and other friends frequently. By the way, I have become president of the Garth Newel Music Center Foundation which is an organization devoted to first class chamber music. You can tell any of our classmates that I would be awfully glad to see them here, should they chance this way, Buxton Farm, Millboro, Va. You see that I am still ambulatory and plan to remain that way for some time."

Jim Flaherty has given up his studio apartment and has moved to the Norwood Retirement Home at 767 Washington St., Norwood, MA 02062. . . . **Harold Neumann** was sky gazing in downtown Des Moines and had a bad fall, breaking a hip, but he is now back at the office again. . . . A note from **John Holton** tells of his Sally having had bad falls and it is doubtful they can make the 65th Reunion. . . . Latest word on **Jack Wood** is that he was to have a peg leg by Christmas. It is easier to picture him that way than on a walker. . . . **Ray Stevens** stays on at the Sherrill House Nursing Home for a while. . . . **Clarence Seely** had "his bumps" in 1981, five times in the hospital.

Should any of you wish to write to a classmate, the Alumni Office or your secretary would be glad to do the forwarding.—**Stanley C. Dunning**, Acting Secretary, 23 Christian Ave., Concord, NH 03301

18

It will be spring when you receive this wish (written January 1, 1982); nevertheless, a healthy and happy 1982 to all of you. I am pleased with the many cards I have received from so many of you. Greetings came from Margaret and **Paul McAllister**, **Beu Greely**, **George Sackett**, Mildred and **Herb Larner**, Winifred and **Sumner Wiley**, and Evalyn and **John Abrams** (and little schnauzer Butch). . . . A most welcome note from Marion (Mrs. **Herb**) **McNary**: "Herb is still at New England Sinai in Stoughton. He is very alert, is typing his own autobiography with one hand, paints, and goes to ceramic classes. I see him everyday."

In answer to my question about the influence of M.I.T. on his career, **Ted Braaten** writes: "I got my first job in 1922 with the Public Service Co. of Northern Illinois through the recommendation of a fellow student at M.I.T. Jobs were scarce and I was lucky to get it. I had just returned from Norway after studying hydroelectric engineering at the Technical Institute in Trandheim and various hydro stations as a fellow of the American-Scandinavian Foundation. One of my professors at M.I.T. recommended me for the fellowship. Just being able to say I was a graduate of M.I.T. surely helped me in later jobs at Westinghouse in E. Pittsburgh and New England, Boston Edison Co., and my last one as general manager of Norwich Department of Public Utilities." . . . **Len Levine** writes: "M.I.T. influenced me to investigate and try to solve problems in the most accurate way. . . . **Eli Berman** and I were invited to participate in the 1982 M.I.T. Alumni Fund drive by telephone at Cambridge. It was an interesting, stimulating experience. I phoned 14 alumni in the classes of 1917, 1918, and 1919 (regular givers) and 13 agreed to give. I talked to some alumni I had known at school and had not seen or heard from since graduation (for example, **Ira Young**, Course II). Some could not come to the phone because of sickness, but their wives acted for them. I belong to two retired men's clubs and attend lectures at Boston University. This with bridge and Florida keeps me going." . . . **Charlie Tavener** sends his greetings as follows: "Never had so much fun at the office eight to five every day. Hope you are all well and will enjoy a healthful 1982. . . . **Arthur Williams** reports the loss of his wife and includes the following comment: "M.I.T. means a great deal to me. I think of it as 'The Best'—none better." . . . Hazel Fletcher, now in Florida until May, sends us her best wishes for 1982. . . . Sad news comes from Jean (Mrs. **Malcolm**) **Baber** telling of the loss of her husband on November 13, 1981, at Hilton Head, N.C. She notes that he was very proud of his M.I.T. association and that they both were very happy to be a part of 1918. After Malcolm entered M.I.T. in 1916, he was asked to join a special training course for inspectors of naval aircraft. He was a commissioned engineer stationed at the naval aircraft factory from June 1918 to January 1919. After World War I, he worked for a New York shipbuilding corporation, Atlantic Refining Co., and Hersey Manufacturing Co. Prior to World War II he volunteered his services to the Navy. In January 1942 he was assigned as assistant to the personnel superintendent, working on the *U.S.S. New Jersey* and *U.S.S. Wisconsin*. He was released from active duty in December 1944 and returned to Armstrong and Baber. He was a member of the International Society of Guatemala stamp collectors; the Auditing and Dinner Committees of St. Andrews Society of Philadelphia, and the Military Order of World Wars, receiving a national citation for "designing, developing, and installing a report and audit system which permits the chapter to control effectively its affairs." . . . A note from Florence Ford records the death of **Karl Ford** on July 7, 1981. . . . We note with sadness the death of **Bob Collier** on December 18, 1981, at his farm in California.

We note that **Harold Weber** contributed chapters to the *History of Chemical Engineering* edited by Dean Furter. . . . We are indebted to Baelah and **Bill Foster** for a well-designed 1982 engagement calendar.—**Max Seltzer**, Secretary, 1443 Beacon St., Brookline, MA 02146; **Leonard I. Levine**, Assistant Secretary, 519 Washington St., Brookline, MA 02146

19

M.I.T. and its Department of Chemistry has a most loyal alumnus in the person of **Bob MacMullin**. A note from Bob advises that he has now completed his autobiography, *Odyssey of a Chemical Engineer*, and has sent a copy to the head of Course X. He sends regards to all classmates, is in good health, and can once again keep up with affairs since he acquired an electronic device that avails him of his peripheral vision. . . . A note from **Louis Grayson** indicates he is looking forward to our next reunion. Meantime, with visits to New England in the early fall and Jekyll Island in Georgia in the winter, he is enjoying his retirement. . . . We are indebted to Margot M. Harley, daughter of **James R. Moore**, for notice of his decease on October 26, 1981. Moore lived in Hightstown, N.J., though he was born in Brookline and lived mostly in Providence, R.I., where he was a very successful yarn broker. He left M.I.T. in 1918 to enter World War I. He is survived by three daughters, two grandsons, and eight step-grandsons.

We regret to report the passing of **Albert Mayer**. Mayer was an outstanding architect in New York who had human beings in mind when designing. He put his ideas into practice in many parts of the world, particularly India. He attended affairs of our class in New York where he discussed his ideas with all who would listen. He is survived by his wife Magda and three children.

We also have notice of the death of **Edward E. Scofield**, Course VI, on August 9, 1981, in Spokane, Wash. Not having other details, I looked up his story as he told it in our 25-years-after class book. He started his career in lumber operations in Wisconsin and Idaho. He moved to the Washington Power Co. and later became a director of the Bay De Noquet Co. I shall aim to get more information and pick up the next 40 years of a grand classmate.

When you read these notes spring will be blossoming out all over: enjoy it while you can. Regards.—**Bill Langille**, Secretary, Box 144, Gladstone, NJ 07934

20

The mid-winter season was warmed by holiday greetings from Betty and **Norrie Abbott**, Beth and **Ed Ryer**, Denise and **K. B. White**, **Ned Murdough**, and **Ming Pai**, who now lives at 17 Alpine Dr., Latham, NY. . . . Winnie and **Frank Badger** write that they are both fine and keep busy at the Rotary Club in Hollywood, Fla., and at gardening (especially a rose garden). . . . Florence and **Lee Thomas** are avoiding winter in Bryn Mawr by spending their time in Naples, Fla. . . . Barbara and **Bill Dewey** write that they enjoyed a family gathering in June to celebrate Bill's 85th birthday at his summer place in Ashfield, Mass. All Bill's children and eight grandchildren were present. "By now," says Bill, "we expected to have become great-grandparents."

Welcome greetings from **Vera Howe** and from **Margaret Brown**, who writes of a wonderful family reunion at El Paso with 15 grandchildren and five great-grandchildren. Margaret mentions that **Count Littlefield**'s wife died and that the **Charles Klinglers**, living in Florida, are traveling quite a bit and enjoying life. Margaret promises to come to New England, and we certainly hope she does and can pay us a visit.

Harold Bibber writes that he and his wife visit Sanibel Island in Florida in the winter. Harold, who lives in Columbus, Ohio, serves as a member of the Guidance Council of the Engineers Foundation which acquaints high school students in the state with what it takes to be an engineer or technician and puts them in touch with the proper sources of education.

Bink Carleton writes that he and Ann took a cruise around South America last April and also visited their eldest son in Germany for the month of October. . . . **George Wilson** writes that he still enjoys his lifetime hobbies: bowling, oil painting, and mineral collecting. He boasts that he still manages to get an occasional 100 in candlepin bowling. . . . A four-word communication from **Gerald Tattersfield** comfirms: "I am still alive." Good for you, Gerry!

News of Technology Day has just come in. Mark the date: Friday, June 11. The usual Pops concert will start off the proceedings on Thursday evening, the 10th. The Friday morning program at Kresge will include a lively discussion on future developments in communications technology and its effect on our personal and professional worlds, to be followed by the usual luncheon. Do try to be on hand. At that time, we'll discuss plans for our 65th Reunion. Think of that! **Harold Bugbee**, Secretary, 21 Everell Rd., Winchester, MA 01890

21

Well, the Christmas season is over and there is no snow on the ground in northern New Jersey. Your secretary is looking forward to leaving for Florida in another week, realizing that when the April *Technology Review* reaches you, he'll be back in New Jersey again.

Most of the news I have this month comes from Christmas cards or letters. I'm grateful to those classmates, wives, and widows who added a note to their greetings. Marion (Mrs. **George**) **Chutter** writes that her summer was a busy one with visits from her sons and their families. Her biggest activity of the year was sorting "stuff" for the annual church auction, whith cleared over $9,000. She missed not seeing Helen and **Bob Miller** this past fall. . . . Claudia (Mrs. **Josiah**) **Crosby** reports that Josh was in the hospital in early December to have "the left carotid artery reamed. He is doing fine but finds it is a long drawn-out time getting his strength back." We hope to see Josh back on the golf course soon.

A long delightful family letter from Ceil (Mrs. **Frank**) **Huggins** of Fort Myers, Fla., highlights her year. "Last July, there was a lovely vacation with my Charlotte folks on Wrightsville Beach, N.C.

Christmas will be festive here in Shell Point, and I'm glad for there will be no more winter visits in the cold North for me. The highlight will be a visit from Tom and my youngest granddaughter, Mary. In the lagoon, Shell Point anchors a large illuminated Christmas tree. Where but in Florida could a tree find itself in such a position? This year we are having 'Luminaries,' candles anchored in sand in paper bags for a half-mile along our water front. . . . This past year I added over 60 plants, mostly shrub type, to the large courtyard. I hauled the plants from the nurseries, dug the holes, mixed the planting medium, and put every plant in place. People talked about how hard I was working, but I explained it wasn't work but my favorite activity. (What a gal!) . . . I still enjoy going over to Sanibel and Captiva Islands. I took on another job there—helping friends with their garden. And, I'm hoping to qualify to become a trail guide. Come see me."

I thought **Bob Miller** was swearing off having family pictures on his Christmas card, but he came up with a family group of 25, snapped at a reunion on June 27, 1981 at Vienna, Va. Bob reports that his acute arthritis that caused him to cancel his fall visit to Cape Cod has been overcome after four visits to an osteopath. He and Helen spent a week with their oldest daughter in a condominium on the beach at Fort Lauderdale, Fla., mid-December. Said he, "Would have liked to stay longer."

Helga and **Jim Parsons** wrote that they were taking off for a South Pacific cruise on the *Royal Viking* in January and would get back to their home in Naples, Fla., about March 1. . . . Betty (Mrs. **Norman**) **Patton** of Dallas, Pa., is still working for the Temple B'nai B'rith and happy with her work. She took a week's bus tour to Florida in February 1981, spent a few days on Cape Cod in July, and then took an excursion bus tour to Quebec in August. Said she, "It's a great way to see the country with no responsibilities—I recommend it." She still does gardening in the summer and snow shoveling in the winter—"I love my snug little nest." . . . **Leo Pelkus** writes: "Sorry I missed seeing you at the Pops. Making the most of a lonely life. Play golf two or three times a week and do a bit of office work. I'm spending two months this winter at our old haunt, Key Biscayne in Florida."

We received notices of two deaths: **Ivan F. Chambers** of Charlotte, N.C., on October 31, 1981, and **Herman Broockmann** of Tucson, Ariz., on November 8, 1981. Besides his M.I.T. degree, Chambers received a degree from the University of Geneva in Switzerland in 1925. He was associated with Du Pont as a chemical engineer from 1928 until 1957. The 1961 *Alumni Register* lists Broockmann as chief engineer of Sanderson and Porter, New York City. The class extends sympathy to the families of these men.—**Sumner Hayward**, Secretary, 224 Richards Rd., Ridgewood, NJ 07450; **Josiah D. Crosby**, Assistant Secretary, 3310 Sheffield Circle, Sarasota, FL 33579; **Samuel E. Lunden**, Assistant Secretary, 1149 S. Broadway, Suite B-800, Los Angeles, CA 90015

22 60th Reunion

Your Secretary at this writing (mid December) is trying to get away to Deerfield Beach, Fla., and is still trying to get books closed and taxes made out. As long as the weather holds out (sunny almost daily with no snow yet) we are not really in a hurry to move South.

We have a welcome card from Carolyn and **Frank Kurtz** on the *S.S. Rotterdam* which tells about visiting their son in San Diego last summer and returning to Delray Beach from San Francisco—Frank's 15th crossing of the Pan-American Canal. They hope to see us all in June at the 60th, but we hope to see them in Florida before then. . . . **Bill Freeman** received a special citation from the U.S. Metric Association "for presenting accurate, unbiased reporting on U.S. metrication in his weekly column 'Metrics,' published by the *Manchester Cricket*." Bill is a metric consultant for the Tower School in Marblehead, where he is transferring a 20-M grid from a map of the school property to the ground. . . . **Bill Elmer**, 2 Chestnut St., Andover, MA 01810, writes that he continues to design reflectors. His garden is growing beets and other vegtables. Cathleen is producing novels and short stories while he has produced opera 26, 27, and 28. He has applied for several patents, including an original system of link measures, and has announced the discovery of a missing term in the classic pendulum formula. Bill is always creating something excitingly original.

We received a lovely picture of Marion and **Norman Greene**, 2140 Mangrove Dr. S.E., Vero Beach, FL 32960. They contributed generously to the Institute as part of the '22 Class Gift. . . . **Royal Stone**, 2855 Gulf-to-Bay Blvd., 55A, Clearwater, FL 33519, sends a Christmas letter telling about his and his wife's life and about their visit to the M.I.T. Florida Festival at Cyprus Gardens and the fiesta at the Mexico City Club. . . . Correspondence from **Parke Appel** is still pushing our 60th Reunion in June 1982. . . . Vickie and **Ed Merrill** have announced their new home at 1722 S. Carson Ave., Apt. 1501, Tulsa, OK 74119. . . . **Oscar Horovitz**, our assistant secretary, is back at Pompano Beach. We hope he is enjoying his usual program of golf and beautiful weather. His conversation with **Arthur Mattuck** has kept the class up to date on what is happening.

We regret to inform you of the passing of many class members during these last months: **Charles S. Comey**, Sun City, Ariz.; **Walter W. Boyd**, Bethesda, Md.; **Abraham Kaye**, Hilldale, Fla.; **Arthur F. Rogers**, Hollywood, Fla.; **Samuel H. Manian**, North Attleboro; **Edward L. Winslow**, Dennis, Me. We are receiving few details, but will try to answer questions for anyone who wishes. The sympathy of our class goes to their families.

We still have hopes for a good attendance at our 60th Reunion in June. A healthful winter to you all and much joy in the spring.—**Whitworth Ferguson**, Secretary, 333 Ellicott St., Buffalo, NY 14203; **Oscar H. Horovitz**, Assistant Secretary, 3001 South Course Dr., Pompano Beach, FL

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Hugh Chase writes that although he is slowing up a bit these days, he traveled back to Georgia for a month to meet his friends and colleagues from the 20 years he was in Atlanta. . . . **Robert Sprague** retired from the MITRE board of trustees at the close of its October 1981 meeting. He had been a member of the board since 1958. During that period he served as chairman (1969-1972), as chairman of the IR&D subcommittee of the trustee Technical Advisory Committee, as a member of the Executive Committee, and a member of the Employee Benefits Committee. In appreciation and recognition of his many years of dedicated service to MITRE, his fellow board members elected him an honorary trustee.

Warren Center died October 28, 1981. After graduating in chemistry with our class, Warren became an assistant in the Organic Chemistry Laboratory at the Institute, and from 1924 to 1926 was a research chemist at the National Aniline and Chemical Corp. in Buffalo. In 1926 he was stricken with polio. For about the past ten years, he was confined to the Cedar Glen Nursing Home in Danvers, Mass.

Samuel Williams died September 18, 1981, in Mary Hitchcock Memorial Hospital, Hanover, N.H. He graduated with our class in mechanical engineering. From then until he retired in 1967 to Enfield, N.H., his birthplace, he was in the employ of the Westinghouse Air Brake Co. For a short period during World War II, he was assigned to the U.S. Navy, Bureau of Aeronautics, with approximately a year at the Institute as a staff member of the Instrumentation (now Charles Stark Draper) Laboratory. With Westinghouse he worked as district sales manager and in service engineering, including product planning. From 1954 to 1961 he was assistant general manager of Railroad Friction Products Corp., jointly owned by Johns-Manville Co. and Westinghouse Air Brake Co., where he developed, manufactured, and sold friction materials for rail vehicle brakes. From 1961 to 1967 he was general manager, then president of the company. He held several patents on railway braking devices and systems. He was a member of the Engineers Club of New York and the Air-brake Association, a life member of the American Society of Mechanical Engineers, and director of the Railroad Friction Products Corp. He enjoyed gardening and photography.—**Richard H. Frazier**, Secretary-Treasurer, 7 Summit Ave., Winchester, MA 01890

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Through the untiring efforts of **Joseph Mares'** widow, we are able to report the death of **Chao Han Shih** in China in 1980. His niece in Princeton, N.J., wrote Mrs. Mares that he was imprisoned during the Cultural Revolution but released in 1973 and reinstated as a research fellow in a large chemical industry complex. Three of his daughters and a son are scientists in China. . . . A very nice letter from Barbara Wood, **Ed Wininger**'s daughter, tells of the sudden death of her mother, Helen Douglas, of a myocardial infarction on November 2, 1981, in New York City. She mentioned how proud she was of her mother and how very important M.I.T. was to her and Ed, a most loyal supporter of the Institute.

Our illustrious class president, **Phil Blanchard**, has emerged from hibernation in Florida. We assume that the state of torpidity can be attributed to semi-retirement and to his success with the benefits of the new MacLaurin Fund, an excellent method of taking care of capital gains and simultaneously supporting the Institute. Phil and Besse were so happy with the mini-reunion in Woodstock, Vt., last June that they enjoyed a ten-day repeat in September. . . . We have a report that **John T. McCoy** has been seriously ill for some time in a New Jersey nursing home. Jack will be remembered as our "Man on the Flying Trapeze." . . . **John Early Jackson** in Virginia, who was one of our sharpshooters and radio enthusiasts, lost his wife recently after 55 years of a happy marriage.

Webster Brockelman passed away in Framingham, Mass., October 26, 1981. He gained his S.B. in Course XV and spent most of his career with Brockelman Brothers Supermarkets founded by his father in 1888. In 1950 Web and his associates founded the Shoppers World, Natick, Mass., one of the first shopping malls in the eastern U.S. He was a former chairman of the Framingham board of selectmen, a director of several banks, and a trustee of Union Hospital. . . . **Paul H. Caskey** passed away in Rockford, Ill., April 23, 1981. He was awarded his S.B. in general engineering. Little is known of his career, but he became vice-president of Illinois Water Treatment Co. in Rockford. . . . **Everett Elting** died October 27, 1981, in Scarsdale, N.Y. He majored in chemistry and took courses at the Wharton School, University of Pennsylvania. He became president of Elting Brothers, New York City, chairman of the board and chief executive officer of Black Mountain Hosiery Mills. Interested in education and aiding undeveloped countries, he became a vice-president of the International Executive Service Corp. and handled projects from Peru to Greece.

Philip C. McGrath left us January 3, 1981, in Pasadena, Calif.Originally from Lockport, N.Y., he was awarded an S.B. and S.M. in chemical engineering practice. Early in the forties, he was located in California and became chief engineer of C.F. Brau and Co., Alhambra, retiring before 1975. . . . We learned belatedly that Professor Emeritus **Benjamin W. Partlow**, Madison College, Harrisonburg, Va., died December 30, 1977.—Co-secretaries: **Russell W. Ambach**, No. 503, 216 St. Paul St., Brookline, MA 02146; **Herbert R. Stewart**, 8 Pilgrim Rd., Waban, MA 02168

25

Spring will have arrived by the time you read these notes which are being written just after

Christmas and provide me the first opportunity to acknowledge with thanks holiday greetings from the following: Lotte and **George Blonsky**, **Franklin Fricker**, Eleanor and **Fred Greer**, Hisako and **Masaru Kametami**, Adele and **Ed Kussmaul**, **Ben Oxnard**, and Elinor and **Sam Spiker**. Also, greetings were received from widows of classmates as follows: Lillian (Mrs. **Garvin**) **Drew**, Frances (Mrs. **Avery**) **Stanton**, and Virginia (Mrs. **Irving**) **Symonds**.

George (the Count) Blonsky writes that all seems to be going well with his move to San Jose, Calif., a year ago. His cataract operations have left him with impaired vision but some of his old humor shows in this statement—"There are several other minor annoyances like arthritis, amnesia, and even plain stupidity which, added together, further inconveniences. I suppose this is only a special kindness of our Creator to ease our transference from this world to the next."

We are still hoping that **Franklin Fricker** will visit us here on Cape Cod some day. He made two trips to Michigan with a stopover in Baltimore for the biennial family reunion. In past years they have gathered in Montreal; Oakland, Calif,; the Jersey Coast; the eastern shore of Maryland; and in 1983 they will meet in southern California. The crowd usually numbers about 40, and Franklin does his part by having four siblings, five children, nine grandchildren and one great-grandchild. Franklin's brother John, '31, who lost his wife last year, has moved to Port Charlotte, Fla., about 70 miles from Naples. Franklin attended Davidson before going to the Institute and therefore learns of sponsored tours from the two schools. He was planning an eight-day cruise in January from Miami to the Caribbean. His brother was planning to go along. Also, Franklin expresses grave concern for the over development of many parts of Florida and the depletion of water resources. Many of us on Cape Cod feel we are faced with similar problems.

Fred Greer reports that Eleanor and he are both fine and now flying back and forth between New Hampshire and Florida in a Lear jet—best time from Lebanon, N.H., to Naples: two hours, 50 minutes. . . . Lil Drew has received notes from many of Garvin's classmates and appreciates hearing from them very much. . . . Frances Stanton writes that she enjoyed a dinner at M.I.T. last fall when Vice-president Bush spoke at Kresge and she saw some '25ers at that time. . . . Virginia Symonds had an unfortunate accident about two weeks before Christmas; she fell and broke her leg. She is home in San Antonio and we hope by now is well on the way to a full recovery.

Those of us who attended the Alumni Day Luncheon last June wondered why **Milt Salzman** didn't make it, for he is one of those who makes a regular appearance. Milt writes that when he returned home from the 55th Reunion in 1980, he found his wife lying on the living room floor semiconscious with a fractured hip and contusions. She had fallen three days previous and was unable to reach a phone. She has been in the hospital three times and is now invalided but gradually improving. Milt finds his outside activities and traveling restricted.—**F. Leroy (Doc) Foster**, Secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650L

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We have commented several times in the class notes on the generosity of our class to student financial aid and now have recognition of this fact in a note from **Dave Shepard** quoting a letter from M.I.T. president Paul E. Gray: "I am writing to thank you for your class's longstanding commitment to student financial aid at M.I.T. Since 1973, when the Charles Stark Draper Class of 1926 Scholarship and Loan Fund was established, the support has been a very special encouragement for us all. The fund is an invaluable resource. Through it, your class has provided us the best possible response to the heavy and steadily increasing demand for aid.This year, for example, 52 percent of our 4,500 undergraduates required some form of financial assistance. With your help, we were able to offer that assistance, and so to uphold the M.I.T. tradition of granting aid to all those who qualify. . . . The generosity of the Class of 1926 does so much to foster enthusiasm and devotion to the Institute. Personally and on behalf of the young men and women who benefit by your concern, I extend heartfelt thanks."

In the previous issue of the *Review*, we mentioned the decision to plan a mini-reunion for 1983. For that purpose Christine Newman of the alumni office has made reservations at the Endicott House in Dedham for pre-Pops dinner and overnight accommodations (June 9, 1983) and breakfast the following morning, June 10. We felt it desirable to plan long in advance because of the tremendous demand for Endicott House at that season.

Evelyn and I have just returned from a brief trip to the West Coast and Mexico during which we had the opportunity of visiting with our son at Palo Alto. We attended with him and his wife a joint meeting of the M.I.T.-Wellesley group which has formed a coalition in San Fransisco. . . . A note from **Cesar Canals** inquires about obtaining a copy of the 1926 *Technique*. Since we have been unable to contact the original publishers, perhaps one of our class members or widows might find it possible to fulfill Cesar's wish for this valued memento. . . . **Crockett Harrison** sends his annual publication of news about his family group, which is scattered throughout the U.S. and Japan—a very interesting method of maintaining family communications. His wife Fanny experienced difficulties with heart surgery from which she now seems to be emerging. . . . Margaret and **Rex Bristol** have been named chairmen of the Norwood Hospital Building Fund. They have been active in community affairs in Foxboro where Rex is chairman of the executive committee of the Foxboro Co.

A letter from **John Ostberg** protests the misspelling of his name on the M.I.T. reunion picture (with an "e" instead of an "o") and mentions collecting some 51 misspellings of his name including "John O. St. Borg." . . . **Argo Landau** writes regretting his missing the 55th. He had a nice visit from **Malcolm Epstein** recently and is now looking forward to the 24th visit to Hawaii this winter. The death of Ros and **Ellie Littman** in the MGM hotel fire was a blow to him and other M.I.T. folk of St. Louis. . . . **Ted Taylor** retired from Western Electric Co. as manager of foreign patent licensing. . . . **G. Warren Bates** is retired. . . . **Leonard L. F. Remington** is past commander, U.S. Coast Guard *Flotilla 1-609*. . . . **P. W. Robinson** is retired and does occasional consulting work for the U.S. Tile Co., Thagard Oil Co., Fontana Paper Mill, and Miller Machine.—**William Meehan**, Secretary, 191 Dorset Rd., Waban, MA 02168

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More classmates have signed up for our 55th Reunion, and several have written some accounts of their quite varied and always interesting activities. Additional names to last months list are: **Anderson**, **Bannon**, **Brady**, **Campbell**, **Darling**, **Fexy**, **Hawkins**, **Ivancich**, **Kaplan**, **Kingsley**, **MacAdam**, **Moser**, **Chungsoo Oh**, **Cole**, **Copeland**, **Gillies**, **Rosanthal**, and **Sanborn**.

After retirement in 1976 from U.S. Postal Service construction in Kentucky, **George Fexy** took a trip to the Pacific Northwest and liked the scenic beauty and economic activity so much that he and his wife moved residence to Kirkland, Wash. He joined the M.I.T. Club of Puget Sound that hosted President Paul Gray in the regional conference in January. George writes: "Our young graduates are aggressive and eager to maintain the M.I.T. banner of excellence."

After retirment in 1969 from 30 years with the U.S. Public Health Service, **Vernon MacKensie** moved to Sanibel Island, Fla., became president of the local planning board, member of the city council, director of two non-profit health agencies, and does fishing and shelling for hobbies. Now moved to Naples, he writes: "Have slowed down in past several years because of cardiovascular-pulmonary chronic disease problems." Seems as if you have spent most of your life, Vern, taking care of others; you are entitled now to keep your own pump going.

Clarence Wynd retired from Eastman Kodak after 40 years. At that time he was general manager, Kodak Park Works, senior vice-president and director. He is now trustee of the University of Rochester and has served nine years as chairman of the Trustees Visiting Committee of the Medical Center. He was founding chairman of the board of overseers of Strong Memorial Hospital. As trustee of the university, he serves on education, investment, and building and grounds committees. As if the above has not been enough to keep him occupied, Clarence has also been a director for ten years of the Center for Naval Analyses in Arlington, Va. We wish you and your wife could take time to attend our reunion.

Note from **Lucas (Luke) Bannon** living in Beverly Hills, Fla.: "Very grateful for cataract operations on both eyes—from legally blind to 20/25 vision—can now see the sun come up each morning." . . . Since retiring in 1971, **William Kaplan** has been occupied in volunteer activities concerned with air pollution legislation in the San Diego air basin. His previous experience in the petroleum industry helps him as secretary of the San Diego Engineering Society and representing AIChE. He also continues membership in SAE, AGS, the Navy League, and San Diego M.I.T. Club. Aside from "minor annoyances of the aging process," Bill says he has no health problems.

Harry Moser, a long-time international patent attorney with G.E., reports after passing his three quarters of a century mark, his wife Pauline looked backwards and forwards and decided to live it up and get going. Already they have tripped and traipsed to Hawaii, California, Pennsylvania, Maine, and Florida. When resting they live in Asheville, N.C. . . . **Charles Kingsley, Jr.** has spent his career as teacher and research engineer in the M.I.T. Electrical Engineering Dept. As a consultant with the Electric Power Systems Engineering Lab, he still has an office at M.I.T. . . . **Laurence Coffin** practices adult education, taking advanced seamanship and job counseling seniors at Maine Maritime Academy. Larry, we expect you to pilot a super-tanker next. . . . We are pleased to hear that **Chungsoo Oh** is again coming to our reunion from Seoul. He has been very active and effective as an administrator of Korean Trade Development Co.

We regret to report death notices of three classmates: **Kimball L. Wheeler** on May 7, 1981, in Cleveland. He had been many years with Cleveland Electric Illuminating Co. and was a fellow in AIEE. **Gustav A. Hagen**, architect, died August 31, 1981, in Tangen, Norway. **Arthur J. Reardon** died on October 19, 1981, in Falls Church, Va. He was a senior engineer with the Army Material Development and Readiness Command when he retired in 1971.—**Joseph C. Burley**, Secretary Protem, 5 Huthchinson St., Milton, MA 02186

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Clifford Terry writes to say that he has now moved from his old home in Indiana to take up permanent residence in Hawaii. The reason, expressed in his own words: "We had been spending the winter months in Hawaii for five years, thus escaping the rigors of Indiana winters which get longer and colder every year. This, together with the grass growing faster and higher, the hills getting higher and the house getting bigger. Last winter, while we were here in Hawaii, we received an offer to buy which was good enough. Both our sons and their families live and work here, so now we can see them more often." To Cliff and Miriam—our best wishes for every happiness in your new home!

A color photograph from Louise and **Ernie Knight** shows them (apparently in excellent health) with their two grandsons, the younger one only a few months old. For 15 years now, the Knights have been spending their winter months

snugged in at their lakeside home in Raymond, Me. Their favorite summer activity is traveling by canal boat through the English countryside over the 21,000-mile system of interconnecting waterways. As a result of his research and writing on the history of his hometown area, Ernie was awarded a certificate of commendation by the American Society for State and Local History. This recognition was at the national level of selection.To you, Ernie, our hearty congratulations!

We were delighted to have a very cheerful letter from Novice and **Tex Sandidge**. It is obvious that Tex loves living in the big state of Texas. He says that his life is still somewhat as it was at M.I.T. since he is now studying statistics, taxes, etc. His eye that was operated on just prior to our 50th now has 20/20 vision. . . . Gracia and **Tom Harvey** reported on the past year's activities of their "clan." All of the young people are doing very well and are a source of pride and joy. Last summer Gracia had to be away for five weeks, and Tom lost six pounds as a result of his own cooking. . . . A year-end report from Dot and **Bill Phillips** tells of Bill's miraculous recovery from open heart surgery in the spring of 1981. In the fall Dot was honored with a testimonial dinner by the New York Speical Olympics for her work with the handicapped. It was a spectacular affair complete with flowers, decorations, and mementos. In attendance were the mayor, legislators, and other eminent personalities. The plaques, citations, resolutions, and gifts testified to the esteem, appreciation, and love engendered by Dot's work. Our sincere congratulations to Bill and Dot!

The tour plans of Betty and **Dud Smith** were deferred last year in favor of a more ambitious trip in early 1982. Betty had lens implant surgery last fall because of cataracts, so she is looking forward to the tour with special eagerness. Understandably, their report contains mostly prideful accounts of their young people. They are especially pleased that granddaughter Judy is a freshman at Wellesley College. . . . Marjorie and **Al Puschin** consider cruise travel one of their major hobbies. They have seen much of the world, and their upcoming cruise (number 29) will take them around Cape Horn with final disembarkation in Peru for a visit to Machu Picchu. When asked why they head for a particular place, the answer is simply, "We've never been there." . . . **Bob Proctor** says he keeps busy with Kiwanis and with his barbershop singing group while Peg keeps the hometown library running. . . .Peggy and **George Mangurian** manage their vacation trips by exchanging houses with someone in the area they plan to visit. Last year it was done with a couple from England, so they had a good view of the royal wedding pair as the coach passed their borrowed apartment. . . . Pam and **Rene Simard** claim to be the class babies and so still have two children in college. Their big excitement now is looking forward to next year and the 55th Reunion.

We regret deeply to report that **Hirsh Sulkowitch** died on September 19, 1981. He had been ill for a long time. Hirsh graduated in Course IXA, general science, then went on to study medicine which led to his M.D. from Johns Hopkins University. He held various prominent research and academic positions in medicine during his active years. To his family we extend our heartfelt sympathy.—**Walter J. Smith**, Secretary, 37 Dix St., Winchester, MA 01890

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Mary and **Frank Mead** live in the best of two worlds, Marion, Mass. (Cape) from May to November and the rest of the time in Northport, Fla. Frank's Christmas card says, "Mary and I enjoy reading the class notes, which are great. Have been a little lazy about M.I.T. and class affairs this past year, but we'll be back in full swing for the 55th Reunion." Mary adds, "I drafted Frank to help me address 200 Christmas cards. He is golfing everyday, while I play nine holes every Tuesday and Thursday, smiling along with my aches and pains. The first thing I do when we get the *Review* is turn to the class notes." . . . **Chung-Foy Yee** sends a Christmas greeting from Canton, China, and wishes all his classmates the best of health and happiness for all of 1982 and on. Chung-Foy visited M.I.T. two years ago, his first since his graduation, and received the "red carpet" treatment by the M.I.T. Administration. . . . Two of our classmates, **Bill Baumrucker** of Marblehead, Mass., and **Warren Walker** of Montclair, N.J., acted as principal hosts. Some of us in Boston and New York attended a luncheon in his honor at the Faculty Club given by the Class of '29. Chung-Foy related some of the hardship experiences that he and his family members were subjected to by the Gang of Four during the Cultural Revolution. Bill and Doris visited Chung-Foy in Canton the following year, as his guest.

Richard K. Opper of Wolcott, Conn., sends a note saying he has had a hectic summer. On June 13 a young fellow driving a camper smashed into his historically preserved old house (1790 vintage), doing $7,000 worth of damage, inside and outside. He has to put up with carpenters, plasterers and painters doing the restoration and the repairs following the accident. Dick's house is full of valuable antiques and he is keenly interested in antiquity—buildings and items of art. For many years, he has been a director of Naugatuck YMCA, Wolcott Historical Society, and Wolcott Republican Town Committee. His advice to us is to "think" young by associating with younger people. Following his own advice, he spends quite a bit of his leisure time with a neighborly couple (ages 38 and 41) who have four teenage children.

George A. Crandall of Casper, Wyo., writes, "I have sold my business and expect to retire as of December 31, 1981. After that, our plans are uncertain. We may come up with something in 1982, either the purchase of a small business or the start of a new one to keep me occupied. My wife Willa and I are planning to attend our 55th Reunion. Greetings to all my friends, especially 'hello' to **Bob Pride**." George lists his hobbies as hunting, fishing, and coin and gun collecting. They have five children, 11 grandchildren and two great-grandchildren.

Al Moore of Rockville Center, N.Y., writes, "It is about time to send you this note and thank you for the birthday greetings which come regularly, reminding me that I am a year older but thankful to be in excellent health living a meaningful retirement life. Nothing eventful, just the same routine of traveling, visiting friends and relatives, and enjoying the quiet life of Rockville Center. Regards to all."

Bill Baumrucker writes from Marblehead, Mass., "Last spring we spent a month in Turkey and Greece. The old Greek cities in Anatolia (that part of Turkey next to the Aegean Sea) are facinating ruins. They include Troy, Ephesus, Aphrodisios, and Pergamum. The Peloponnesos area of Greece is equally interesting. It was a great trip. In July I went to Labrador with **Frank Mead** for salmon fishing. Then in August we took a trip up to Eskimo country, 2,100 miles north of Montreal and 420 miles north of the arctic circle, fishing for arctic Char, a fish like salmon only more powerful. It is a wild country but with nice people. Doris and I are both fine and enjoying good health. Greetings to all." Bill has been a most active and generous member of our class. He has been on the executive board for many years, holding such offices as vice-president, president chairman of one of our major reunions, and others. During the past year, I have had the pleasure of being with Bill and Doris on Technology Day, the Alumni Officers' Conference, A.O.C. meeting and Alumni Council meetings. Bill also has had a colorful and brilliant career. He was a structural engineer for Curtiss-Wright Aero, an assistant production manager for the New York *Daily News*; business manager for the *Boston Herald*, and senior vice president for Charles T. Main, Inc. His hobbies are tennis, sailing (Eastern Yacht Club, Marblehead), and traveling (as much as he can and all over).

Fred Celler of Maitland, Fla., writes, "I received the birthday greetings when we returned from our annual four-month sojourn in Paris, where I pursue business activities as well, this year being dismal. But friends, good restaurants, and golf in Saint Cloud made it worthwhile." Fred and his wife Margery have attended a number of our five-year reunions. Fred is unofficially known as ambassador-at-large for Franco-American affairs, having membership in a number of such organizations, fostering a good relationship between two traditionally friendly countries, France and America. Fred's loyalty is equally divided between his native and adopted countries. He was president and directeur general of AMP de France in Paris from 1961 to his retirement in 1974. He was president of the M.I.T. Club of France, a director of the American Chamber of Commerce in France (president 1975-1976), commander of the European chapter of the U.S. Military Order of Foreign Wars (1965-1970), and vice-chairman of the American Bicentennial Committee in France. He was decorated by the French government in 1970, conferring "Officier de l'Ordre National du Merit."

Charles B. Bacon of Middletown, Conn., has been the recepient of an Outstanding Citizen Award for 1981 from the Northern Middlesex Chamber of Commerce. He is president and chief executive officer of Bacon Brothers, Inc., general contractors. His career has evolved around public water supply and waste treatment, having served as chairman of the Middletown Water Pollution Control Authority. He is a past president of the Middletown Rotary Club, the University Club, and the Northern Middlesex Chamber of Commerce. He has served for many years as deacon and trustee of the First Church of Christ. He has also served as director of Liberty Bank for Savings, Middlesex Memorial Hospital, and is presently a member of the Inland-Wetlands Commission. . . . **William F. Jenkins** of Manvel, Tex., was one of three honored during the 75th birthday celebration of Alvan State Bank. He was presented with a pulsar quartz watch, which, he says, is "a lot smarter than I am. It is programmed to keep track of the days and dates until the year 2066. There are a number of things it can do, but I will have to go back to M.I.T. for a refresher course to program it. It is a great watch—too bad it can't wash windows or type."

A note from **Rolf A. Zurwelle** of Walhalla, S.C., reads, "By the grace of God, I have just become 75 years old and still feel healthy and spiritually young. I am still active in my business (Zurwell Co.) designing products and continue research into the service of gravitation and other matters. In my spare time, I teach the illiterate to read and write and I also conduct an adult Bible class. My best wishes to all." . . . **Edward R. Godfrey** of Huntington, N.Y., writes, "We lead a quiet life mostly revolving around family members, which total about 18 and live within a 100-mile radius. The only change of my lifestyle was the trauma of selling my cruising yacht which we enjoyed very much. As a compensation, I purchased a lively 23-foot day sailer which we enjoyed last summer. In April, all our family gathered for a big party celebrating our 50th wedding aniversary." . . . **Harold C. Pease** of St. Petersburg, Fla., writes, "I was glad to see you and **Bob Pride** at the 1981 M.I.T. Festival in Cypress Gardens last February. I had a great time and met some other classmates whom I hadn't seen for a long time. I have been taking it easy lately, though I took a trip to Massachusetts last July to see my son and his family. They gave me a wonderful birthday party. In November, I am planning to fly to Europe and take a bus tour around southern France and Italy and back to the U.S. by ship."

Adolf J. (Jack) Dietsch of Sonoma, Calif., writes, "Knowing my background to be engineering, I was recently approached by the local Retired Senior Volunteer Program organization to design a motor-driven, foot-operated winding machine for a company involved in rehabilitation work for the physically disabled. It sounded interesting and challenging, so I polished up my old equipment and built a drawing table, and board, and am at it 'hot and heavy.' " . . . A sad letter from **Bill Young** of Old Saybrook, Conn., reads, "It is with deep regret that I inform you that my good wife Jane died on December 18, 1981 after a seven-year battle with melanoma. As you know,

she made many M.I.T. friends at the last three reunions we attended. Dr. John Kirkwood, melanoma specialist at the Yale-New Haven Hospital, wrote to say that her case contributed substantially to medical science's knowledge of this dreaded malady. So, she did not die in vain. Last March (1981) when Jane was still able to travel, we spent an enjoyable week with Helen Hamilton in Boca Raton."—**Karnig S. Dinjian**, Secretry, P.O. Box 83, Arlington, MA 02174

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Bob Reynolds calls my attention to a bit of M.I.T. genealogy. It seems that Bob's grandson, Robert Wood Reynolds III, has a quadruple M.I.T. ancestry. Bob's son (Robert II) married the daughter of Fisher Hills, '29, whom many of you may remember. Since Bob's father, the original Robert Wood Reynolds, was in the M.I.T. Class of 1902 and Fisher Hills' father was also an M.I.T. alumnus, Robert III has two M.I.T. grandfathers and two M.I.T. greatgrandfathers. . . . A note from **Ted Bridge** reports that he had a quadruple bypass operation about a year ago, and thereafter the Bridges moved to Walnut Creek, Calif., to be near their married daughter and new grandson (their first grandchild). Ted was a home computer enthusiast in the days when home computers were a rarity and has maintained his interest in this field. . . . **Bob Armstrong**'s wife has acquired a considerable reputation as a sculptress working with stone. She has exhibited in galleries in New York, where her award-winning sculptures may be seen, and elsewhere. Bob says, somewhat ambiguously, that he now "works for" Jane but does not specify whether this involves (for example) holding a chisel or perhaps transporting the finished products.

Those of you who came to the 50th Reunion will recall that the classmate who traveled the furthest to the reunion was **Ching Yang** (with wife Sally), who is adjunct professor of management at JIAO-Tong University in Shanghai. Ching sends a copy of an article published in the *San Juan* (Puerto Rico) *Star* authored by Julian Rice who (with his mother, Mary Plummer Rice, '51) visited China last summer and was entertained by the Yangs in their Shanghai home. It appears that Ching has become a sort of unofficial greeter of U.S. quasi-official and trade groups visiting Shanghai. For example, he participated in hosting a group of some 26 M.I.T. alumni and their spouses who visited Shanghai last spring and, more recently, a group of Thiokol Corp. representatives.Ching is also a home computer enthusiast with a Hewlett-Packard terminal in his home. The Yangs have six sons and a daughter, most of whom live either in the U.S. or Taiwan.

As previously reported in the Notes, Helen and **Hank Bates** have established a retirement home in Los Altos, Calif. Hank writes that he was forced to miss the 50th Reunion, the only one he has missed, for health reasons, but is now feeling much better. He further reports that Evelyn and **Dick Phillips** helped the Bates celebrate their 50th wedding anniversary. . . . **Al Bird** and his wife have retired to Rockport, Me., where his activities include "small boat (wood) building, sailing, six years as Rockport selectman, and past president of the Rotary Club of Camden, Me.—**Gordon K. Lister**, Secretary, 294-B Heritage Village, Southbury, CT 06488

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Jack Lane writes: "Today (December 20, 1981) it is 90 months and 20 days since I gradauted from Mobil. During the latter part of 1974, I consulted for Condat SA in Lyon. In 1974 I was re-elected to the National Lubricating Grease Institute (NLGI) board of directors, where I am still serving but now as a consultant for Total Compagnie Francaise de Raffinage, an integrated oil company headquartered in Paris. Business trips to France have been once a year for a little over a week, late in April or early in May. Included in my assignments for Total are keeping them advised of activites in technical and trade societies related to petroleum products such as societies of automotive engineers, American Society of Lubrication Engineers, American Society for Testing and Materials, American Petroleum Institute, National Petroleum Refiners Association as well as NLGI mentioned above. Total also likes to know of developments in the U.S. automotive and industrial scene, so I supply some of that information. I also help in receiving approval of Total lubricants by the U.S. Army and industrial accounts. More and more, the U.S. technical societies are becoming internationalized so people from Total CFR are presenting papers at the conferences in the U.S. I help put some of the papers in American English rather than French English to facilitate understanding here. There are a multitude of other product related activities from diesel fuel, gasolines, oils, greases, and hydrolic fluids to waxes, asphalts, and technical tests to evaluate them with which I am concerned." Thank you, Jack, I wish everyone would be as helpful. Such notes would be a lot more interesting to our classmates.

On their Christmas card, **John Minami** wrote that he will try to get some news to me soon. I hope he will. It was fun getting together with him and Yoshiko before I retired when I was visiting Japan regularly. . . . **Eliot Graham** writes: "Missing the 50th Reunion was a great disappointment for both Jo and myself. Neither of us felt up to the rigors of the cross-country trip. I think I've found out why. A re-examination of the 'owner's manual' reveals that our model was only warranted for the first 70 years." . . . Received a card and note from **Dick Blasdale** and was saddened to learn that Rhona died three years ago. . . . A nice note from Jan and **Larry Barnard** says they hope we can join them on Longboat again this year in April. . . . And Hope and **Randy Binner** write that they enjoyed the reunion and are looking forward to the next one very much since Alaska is on their list. They report everyone is fine there and the children are busy and happy and excited about their work. Curling is still going strong with them, and the "good old boys" curl every Wednesday p.m. . . . Clare and **Ben Steverman** write that they enjoyed the reunion and loved their time getting together with the classmates at Martha's Vineyard.

Mardy and **Fred Elser** write that they are looking forward to their 50th wedding anniversary on February 6, adding that their daughters will be there. A card to Fred from **Cliff Harvey** (Amateur Radio W1RF) tells that his rhombic antenna was blown down in a storm. Fred also reported that he had a card from Betty and **Roger Wilson** whose address is 309 Hillandale Ave., Belen, NM 87002. . . . A Christmas note from Charlotte and **Ed Hubbard** includes the following: "The Harbor View was an excellent choice—we only wish we could have stayed two more days—such excellent food and, as we were in the new wing, our view was very pleasant. We are picking up pieces slowly but the loss of our only son has left a large void in our lives. As they say, the show goes on." Our sincere condolences upon the loss of their son. . . . **Benjamin S. Mesick** wrote the Alumni Association as follows: "Professor of mechanical engineering at the University of Arizona from September 1959 to May 1969. Retired completely but am supposed to be writing my memoirs (am only up to 1951). Enjoy bowling each Thursday during school year as a member of the University of Arizona faculty and staff team.

In closing, it is with considerable sadness that we report the death of three classmates. On November 13, 1981, Mrs. John Page wrote the Alumni Association: "It is with deep sorrow that I must tell you of the death of **John Page**, my husband of almost 46 years. His entire professional life was with the U.S. Gypsum Co. in Chicago. He also served in World War II with the B-29 bombers, the 444th Bomb Group. He received the Legion of Merit from the U.S. Congress for his work on the B-29 engines. He also held the distinguished Flying Cross with clusters and Air Medal with clusters. For his company, he held many patents (I believe 16). He will be greatly missed by all." Our sincere condolences to Mrs. Jane Page. Although the following deaths were reported, no further information was given: Marion (Mrs. **Harold C.) Wilkins**, on April 22, 1981, and Captain **Norman E. Blaisdell** (actual date unknown). —**Edwin S. Worden**, Secretary, P.O. Box 1241, Mt. Dora, FL 32757; **Ben W. Steverman**, Assistant Secretary, 3 Pawtucket Rd., Plymouth, MA 02360; **John R. Swanton, Jr.**, Assistant Secretary, 27 George St., Newton, MA 02158

32 50th Reunion

All plans are set for "Go" on our 50th Reunion. Returns indicate that we will exceed the projected 165. To procrastinators: Hesitate no longer—write that you are coming!

Samuel Paul expects to be at our reunion. On his way from California he will stop in Toronto to present a paper, "Primary Care and Emotional Illness," at the Annual American Psychiatric Association meeting. . . . Betty (Tatterson) and **Ken Smith** enjoy their Florida winters at Indian Rocks Beach. IN the summer they visit their children and grandchildren in Idaho, Kansas, and Georgia. His hobbies are Kiwanis Club, community service, and golf. He loves to hear from his fraternity brothers (Phi Sigma Kappa) and old friends. . . . **Adolph Warsher** tells us that he has lost his wife Majorie after a long bout with cancer. Thus ended 46 years of mutually enjoyable partnership. In order to find a new activity that would not remind him of his old life, he decided to take up flying. He has joined the National Beechcraft Flying Club, flies at Hanscom AFB, and hopes to get a private pilot license with an instruments rating.

We have heard from **F. Carlyle Roberts, Jr.**, P.O. Box 737, Patagonia, Ariz. Although he only spent one year at M.I.T., he is eternally grateful for having learnt to "work his tail off" and "associate with very smart, constrained people." He says, "Come and visit me, close to the Mexican border, and see what a guy can do with his own hands." Sounds like a good invitation. . . . **Francis T. Cowen** keeps busy refurbishing old houses in Newton and at the Cape. This summer he annd his wife entertained ten of their Italian friends at the Cape, and in the fall they plan to go to Italy to join them in the grape harvest. . . . **James G. Ritchey** retired in 1977 from industrial engineering. Now, he and his wife Esther are growing older as gracefully as possible. They are doing special seminary studies and some hospital work. . . . **Stanley L. Johnson** is still employed as resident engineer of a New York City sewer construction project on Staten Island. This entails 80 miles of daily commuting. His son is in West Virginia, and the grandchildren are studying at various schools and universities.

James M. Shackelford has been a resident since 1979 of Westminster Village Kentuckiana, a most delightful and attractive environment for retirement living, in Clarksville, Ind. He strongly recommends it to anyone in that part of the country looking for a change. . . . **Gene Lynch** writes a long letter detailing how he missed the 25th, 30th, 40th, and 45th reunions. Many times it was emergency travel assignments, sometimes, personal health problems. He is determined, God willing, to make the 50th. We are looking forward to seeing you, Gene! . . . **James J. Robson** sends us an enthusiastic letter from Portola Valle, Calif., extolling the virtues of life in the San Francisco Bay area. His wife Winifred and he are busy taking care of their two-and-one-half acres, hosting visits from their daughters, and traveling. Right now they are looking forward to a Stanford South American seminar in Brazil and Peru, and to the 50th Reunion in Cambridge (ours, of course).

James reports the death of our classmate **G. Donald Freeman** on December 5, 1981. His wife Dottie would appreciate a call (714) 728-4899. Her address is 942 Tomorrow Ln., Fallbrook, Calif. . . . It is with sadness that we must report that **Robert H. Hubbell, Jr.** died of cancer last June, and that **Donald I. McSheehy** has passed away. Our class condolences to the families. Any obituary information we get will be passed on to our classmates. —**Melvin Castleman**, Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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Headlines this time belong to **Jack Frost Andrews**. Jack, now retired from the New Jersey Highway Department, has been a most faithful correspondent. He mentions **Doug Stewart**'s passing, which was already reported. Doug must have been a great "Fella," according to the civils who have mentioned him. Although I did not know Doug personally, I feel as if I did from reading his wife Louise's letter, sent to us by Jack. Many thanks, Jack.

Another faithful friend, **Horace MacKecknie**, comes through with a year-end family letter. He has recovered from last year's heart attack, after which he had surgery to repair the damage. The Macs flew to Radcliffe for Prue's 50th class reunion, then on to visit relatives. Another 50th: children Joan and Margaret were hostesses at a great 50th wedding anniversary celebration for Prue and Horace. The bride and groom then took a short trip to the Amish area in Pennsylvania to visit the cemetery and the Longwood Gardens. Horace is at it again! He is first vice-president of the Alexandria Chapter of the National Association of Retired Federal Employees. Perhaps it is evident why we love to hear from the Macs of northern Virginia.

We have a Christmas card and a dang nice note from the one and only **Carl G. W. Swanson**, now of Newtown, Conn. He asks that I continue to write the class notes. If elected next time, I would be happy to accept *if classmates vow to send me at least a paragraph every month.* I hate stretching out material for lack of class response. Carl says nothing about himself but mentions that Katherine has had the old favorite, shingles, since December 1979. Katherine, you have our sincere sympathy. She also had a bad fall quite recently. Be careful, Gal!

We have two Fund capsules to add to our meager supply of personal news this time. **Fred C. Walker** says ulcers, angina, and other physical ailments limit his activities to care of the garden, walking, and reading technical papers. "No increase in pension funds this year." . . . **W. Cotton Cooper** retired in June 1981 from his engineering position with the Department of Facilities Management at the University of Missouri. (Golly, could he know Elmer "Slick" Henderson, my kissing cousin?)

I thank you fellas who sent Christmas cards which were received early and left at the farm in New Hampshire. One did get forwarded to Florida—from **William D. Harper** of Hattiesburg, Miss.—**Warren J. Henderson**, Secretary, P.O. Drawer H, Exeter, NH 03833

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This month I have a number of Alumni Fund notes. **Tom La Cava** writes, "Officially retired but still at work in sanitary engineering with the New Hampshire Water Supply and Pollution Control Commission. We spend much time at our summer home on Cape Cod—complete retirement is eventual." . . . I have a real stab in the dark from **Joseph Dauber**; if anyone has a copy of the 1934 *Tech Show*, he (as co-author) would like to get it reproduced. His number is (714) 768-0452. It will really be a miracle if there is still a copy of the script in existence. . . . **Daniel MacKillop** writes, "Retired September 1975, physician, radiologist." . . . **J. Palmer Boggs** writes, "I retired from the University of Arkansas in 1976 at age 70 and continue a limited practice as a consulting structural engineer." . . . **Walton W. Hofmann** notes, "From sunny (mostly!) California my spouse Edith and I enjoy retirement. We live in 'Silicon Valley' and do our boating on the 1,200 miles of San Francisco Bay and Delta waterways and our winter sports in the High Sierras. Our children and grandchildren are scattered across the continent. Our welcome mat is out to all fellow alumni who wish to partake of the California scene."

I have one loss to report this month—**Francis Buresh**. He died November 2, 1981, in Plattsburg, N.Y. at the age of 72. He retired some years ago and was living in Au Sable Forks. As a design engineer, he designed and built a random web process machine used in the non-woven fabrics industry. Prior to that, he was an engineer at the former Fisk Rubber Co. in Chicopee, Mass. He was also a former member of the New York Blandford Club, Rotary Club, and the Wilmington Community Church. Francis is survived by his widow Josephine, two daughters, and five grandchildren. For all of us, I express our sympathy to Mrs. Buresh on her loss.

This is being written early in January and I am happy to have received, with greetings not to me but to all the class, Christmas cards from two far-flung members of our class. Both are from mainland China. One was from **Ming Li Loh**, about whom I reported about a year ago. He is still teaching at the South China Institute of Technology in Canton. The second card was from **Wing Lem Wu** who has been at the Beijing (formerly, if I am right, Peking or Peiping) Institute of Aeronautics and Astronautics for the last 30 years. He is now teaching and doing research in connection with wind tunnels. Both have expressed their pleasure at being able to communicate again with M.I.T. and their classmates. Since in each case the cards were addressed to my home address, it seems that the *Review* is getting through to them. It occurs to me that with the increasing number of people visiting China nowadays, some of you might have both the opportunity and the desire to write these former friends. I have their addresses and will be glad to send them to any of you who want them.—**Robert M. Franklin**, Secretary, 620 Satucket Rd. (P.O. Box 1147), Brewster, MA 02631; **George G. Bull**, Assistant Secretary, 4601 N. Park Ave., Apt. 711, Chevy Chase, MD 20815

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As I promised last issue, here are excerpts from **John Mooring**'s letter written from Salinas, Calif., last October. "**Otto Zwanzig** was recently in Bogota, Colombia, on a three-month assignment 'to project the international coal trade to the year 2000, with particular regard for the soon-to-be-developed Columbian coal resources.' A quick catch-up on the family: Sally, our oldest at 37, and her family are in a rented townhouse less than one-quarter mile from us. Skip (John), 33, is in Washington, D.C., between assignments. Robin (Roberta), 27, is based in Anchorage where she is a habitat biologist with the state. (She was going to Europe in December.) Wife Bobbie is now completely involved—plays wife, mother, grandmother and volunteers at John Steinbeck House and Wild Life Rehabilitation at SPCA. Result: we are now a two-car family—hers, a sunshine yellow Datsun 210. As for myself, it's Hartnell College. After taking two courses in computer programming—BASIC and PASCAL on Apple computers, I'm now taking them apart and repairing them. And, piano continues. I'm also group travel consultant with Your Travel Agent, the oldest agency in Salinas. Doesn't give much money for the time spent, but the cheap travel opportunities are unlimited, especially starting next June when airline discounts begin for me. Bobbie and I are celebrating our 40th with a trans-canal 13-day cruise on *Royal Viking Sea* in January." It's nice to hear from you, John, and many thanks to **Bud Pflanz**.

Herbert Anderton called me from his home at 23 Brandywine Ct., Cotuit, MA 02635, to tell me of **Charlie Bowen**'s death—they had grown up togther. Herbert retired as vice-president in charge of foreign insurance and reinsurance with Liberty Mutual in 1979. His son lives in Medfield with his wife and one child, and his daughter lives in Needham with her husband and three children. Herbert told me he used to play golf long ago (I asked him) and took some golf lessons this fall to play again. We'll get him to join the 22nd Class Golf this spring.

Now some notes through the Alumni Fund Office. **Wes Loomis** announces that he was elected to the Independent Telephone Hall of Fame last October. Congratulations from your former classmates! . . . From **Robert F. Kennedy**: "Anyone want to buy a spanking clean, three-bedroom townhouse on a golf course here in Tucson? Haven't sold it, although we moved to a larger home in July. We think the area is great. We're fixing up our 'new' eight-year old house inside and out; there seems to be more to do than hours in which to do it. Would like to see any classmates that come by—(602) 749-5177." . . . From **Sam Brown** in Short Hills, N.J.: "Next year I hope to re-enter the Golf with vigor—well practiced after nearly six weeks in Florida. Perhaps I can get **John Brosnahan**, **Hal Bemis**, and you to play a match on my home Canoe Brook turf."

I am sorry to announce the deaths of three more '35ers. **Gordon C. Edwards** died in 1977 in Springfield, Va., a Course X man our first year; **Frederick Pruyn, Jr.** died in 1979, a Course XV man our first year; and **Gerard Degelder** died June 18, 1981 in Des Plaines, Il. I am sending regrets and sympathy to their widows.

Welcome to spring!—**Allan Q. Mowatt**, Secretary, 61 Beaumont Ave., Newtonville, MA 02160

Disturbed at some recent articles advocating "evolutionism" in the *Review*, **John W. King,** '34, has written the following: "How can evolution explain the fact that a common gopher has several equally-spaced dark stripes on its back, and between these stripes rows of equally-spaced small round spots of dark fur? It looks to me like a gopher's fur would have to have been designed on a drafting board. It staggers the imagination to believe that such a design could have develop haphazardly through evolution."

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These notes which you will read when spring is well in hand are being writen on a day when the thermometer outside the window above my typewriter has finally climbed to the "0" mark—Fahrenheit, not Celsius! Much of the material I receive is often far from recent, so with great pleasure I pass on a note from **Leo Kramer** which I received this morning! Leo responded to **Harry Essley** telling of his experiences in Alaska last summer and sent me a copy. He reports that he continues consulting three or four days a week with two clients in the management of electronics engineering and manufacturing. He says **Ed Dashevsky** has asked him to join in a series of seminars Ed is conducting for manufacturing enterprise executives this spring at Babson Institute. (I think Leo is typical—most of us do not find time hanging heavily on our hands even though many of us are formally "retired.") . . . More reunion biographical information, and another example: **Henry Runkel** is a visiting adjunct professor at Gonzaga University in the Department of Education. In his 30 years with Boeing (without ever working on a Boeing airplane), one of the highlights was his work on the Apollo program. In 1976 he was named outstanding technical manager of the year (for cruise missile development) by the Pacific Northwest Section of the AIAA. During the years he has helped found several churches and has served as a deacon, elder, trustee, and church school teacher, as well as on school advisory boards.

Edward Rowe, in retirement, is president of the board of trustees of the Waterford, Conn., public library. He writes that he was involved in shipbuilding for 16 years at Newport News and then for 27 years at the Electric Boat Division of General Dynamics. His final position was chief of cost estimating. He feels that a most interesting experience was being aboard the *S.S. United States* for her two sea trials. Involvement in the construction

of the *U.S.S. Nautilus* and other early nuclear submarines has given him great satisfaction. He has also been active in town affairs. . . . **Charles Rife**, M.D. is an ophthalmologist in Mechanicsburg, Pa. He has served as a judge at the local science fair and published one book. He implies that his single life is quite uneventful, but maybe he just doesn't want us to know too much about him! . . . **Laddie Reday** must occasionally be at home in Newport Beach, Calif., but he is frequently in some far away place like Tierra del Fuego, Outer Mongolia, or the Australian Outback. He is president and owner of Newport Properties and is engaged in building, trading, and leasing industrial buildings. He has a "small" ranch in Riverside County where he is growing jojoba beans which he feels may be the oil of the future. He also does considerable free-lance writing and has published two books. His civic and volunteer activities have covered the arts in Orange County; he went on the Fahnstock South Seas Expedition; has served as port captain in Manilla and vice-president of Everett Steamship Corp. in Kobe, Japan.

Charles Price also lives in Orange County (Santa Ana, Calif). He retired in April 1981, having been district manager for Paulsen Wire Rope Corp. Until he retired from the Army Reserves, he continued competitive marksmanship and was captain of the All-Army Reserves pistol team for the national matches in 1965. He reports his principal hobby is sailing, and now that he is retired he hopes to do some offshore cruising in his Rawson 30 cutter. . . . **Edward Pratt**, another M.D., is too busy as professor in the Department of Pediatrics at the University of Cincinnati to do more than tell us that he has been president of the American Pediatric Society and was chairman of his department for 15 years. I did report more on Ed some months back, so that will have to suffice. . . . **Wilfred "Wiley" Post** left M.I.T. to earn a degree in aviation administration from Parks College of Aeronautical Technology at St. Louis University. He flew for an air commuter service before moving to the Allentown-Bethlehem-Easton (Pa.) Airport in 1937. He is airport manager and has received many awards and recognition for his long service to the industry. . . . **Frank Phillips** is retired from the New Jersey Bell Telephone Co. and in 1977 he and Phoebe moved from New Vernon, N.J., to Brownsville, Vt. While in New Jersey, he helped to defeat the New York Port Authority's attempt to take over New Vernon for a fourth New York airport. He also talked to high school, college, and business groups about free enterprise, taxes, etc., and rode to the hounds for several years, being thrown several times.—**Alice H. Kimball**, Secretary, P.O. Box 31, West Hartland, CT 06091

37 45th Reunion

Joe Smedile, 3579 Admirals Way, Del Ray Beach, FL 33444, writes, "This is our second Christmas in our new home, having moved in on December 10, a year ago. You would think that by this time we would be settled. But, not so! The workmen are still correcting problems identified in our original inspection before we moved in. Early this month, they yanked out our heating-air conditioning unit. They are now relocating it, the ducts and power lines. Half of our upstairs is all torn up. They promised they would be done by Christmas. We love our home and have learned to share it with various workmen and occasional visitors. We are on the Intracoastal Waterway that provides an inside passage for small craft from Maine to Texas. Thus, from our dining room and kitchen windows, we are treated to an endless parade of pleasure boats annd commercial tows. Literally, they pass by our back door at distances of 25 to 50 feet. After all these years of seeing back yard fences from similar rooms, this is quite a treat, especially for Martha. We have spent a quiet year, mainly waiting for repairmen. We are looking forward to our 45th." . . . **Joe Heal** wrote from 605 Rountree Dr., Longboat Key, FL 33548 in December, saying he heard the weather up here had been rough, and that he is looking forward to seeing you all in the spring.

Norm Birch writes: "This has not been the best of years for us. While we have been well ourselves, there has been much illness in the family. Elvie's mother has been a big worry. She fell four times within a two-week period in April, ending up in the hospital after which she had to go to a nursing home. Son Alan's family was here for six days over the holiday, and it was fun having them with their two lively little sons. They moved from Corning, N.Y., to Louisville, Ky., this past summer but will be returning to Corning for Chirstmas, so we'll all be together there. They will stay with Cathy's mother and we'll be at son Eric's but the houses are next door to each other. With five grandchildren, we'll have fun." Norm plans to be at the 45th. . . . **John Jacobs** writes, "We have been in Calgary for over a year, where I have developed a mathematical model of the Alsands Project (a $14 billion tar sands mining operation). Did a lot of skiing around Banff-Norgnay. Heading back to San Francisco at the end of November 1981 to be ready for Squaw Valley season. Have been windsurfing and playing racketball since April."

George S. DeArment writes: "Retired on January 1, 1981, from Channellock, Inc. Now acting as chairman of the board. Still hold directorships with Northwest Bank in Oil City and Mid Pennsylvania Telephone Co. in Kittanning. Also serve as trustee of the Presbyterian Church in Meadville, Pa., and director of Meadville Area Recreation Authority. Spend winter in Florida where golf is the regime."

It is with deep regret that I report the deaths of Lieutenant Colonel **Gregory P. Villaflor** on June 7, 1981, and **Louis Pepperberg** on October 2, 1981. Greg died of a heart attack. His address was Hibernia Rd., Salt Point, NY 12578. L.E. Pepperberg's son David wrote saying his mother was still living at 143 Green Bay Rd., Highland Park, IL 60035.—**Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, MA 02155; **Lester M. Klashman**, Assistant Secretary, 198 Maple St., Malden, MA 02148

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Mark June 11 on your calendar. Not only is it Technology Day, but we are going to hold a class dinner at Endicott House in Dedham that evening. Reunion Chairman **Don Severance** has made arrangements—more later. Don has also announced that our 45th Reunion will be held at the Wianno Club in Osterville on the Cape.

Russ Colle has returned from his stint in Brazil, where he worked for the Brazilian Navy, and is now exploring some applications of information science with respect to problems of less developed countries. In his spare time he is developing mathematical toys for teaching remedial math.

Bill Brown retired last year to the Bay Area and spends his time either traveling or auditing classes at the University of California, Berkeley. . . . Another retiree is **Frank Gardner**, formerly director for science, regional office of the Office of Naval Research. Frank is now in residence in ski country—Grantham, N.H. . . . **Bruce Leslie** also retired as senior vice-president of Allendale Insurance, part of the Factory Mutual System, and now lives and sails on Narragansett Bay when he is not traveling. "Hobby: railroad late-model steam."

We just learned that **Allen Cherry** passed away last September.—**Armand L. Bruneau, Jr.**, Secretary, 663 Riverview Dr., Chatham, MA 02633

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Harold Chestnut was awarded the 1981 Honda prize of $44,000, plus a medal for his pioneering research in the field of eco-technology. The award was made in Tokyo during ceremonies after Hal had spoken on "Applying Technology More Effectively to Meet the Needs of People." . . . **Clint Lowery** retired from GE's Knolls Atomic Power Laboratory, and Hal Chestnut attended the retirement party. Clint's interesting career included a recent trip to Ecuador, Peru, and Brazil where he and Faith visited hydropower plants, radio transmitter installations, and missionary establishments in the jungle on the Amazon side of the Andes. . . . **Bob Pratt** is vice-president of programs for the M.I.T. Club of Cape Cod, a trustee of the First Congregational Church, and sometimes commanding officer aboard his Marshall 22 catboat.

Mike Herasimchuk was elected president of Mold Management Corp. of Bethlehem, Pa., a new corporation dedicated to the promotion of domestic and foreign steelmaking technology. . . . **Leo Kiley** is in his third career as manager of corporate planning to the Los Alamos Technical Associates, Inc. Leo and Luna recently met the **Morgan Sze**'s at Portsmouth, Me., where they had a mini-reunion. . . . **Wiley Corl** is vice-president of the M.I.T. Club of Palm Beach County, Fla. After completing his seventh attendance, Wiley recommends, with enthusiasm, the annual M.I.T. Fiesta in Mexico. . . . Peg and **Roy Haworth** sold their Plow-Coa Co. and are planning a trip to China where they hope to visit Julie and **Charlie Wang**. . . . **Ted Wroblewski** completed 32 years with GTE Sylvania in 1972 and now does business consulting. These days Martha helps him on other consulting—on tennis courts, skating rinks, and cross-country ski trails. . . . **Wallace Warner** is doing well after his recent heart bypass surgery and in his retirement from Dravo. Wallace and Evelyn traveled from Pittsburgh recently to visit Ted and Martha in Danvers, Mass.

Solomon Baker is vice-president, Interconnector Products Group, Rogers Corp. Sol has been with this company for 20 years. Also, he serves on two Boards of the American Jewish Congress. . . . Nancy and **Gordon Pope** and Lucille and **Bill Brewster** were planning a trip to the Pacific Southwest where **George Cremer** and I were looking forward to another mini-reunion. Just before departure Nancy had a stroke and was hospitalized at Wolfboro, N.H. We hope her recovery will be complete and rapid and that we can remake their reservations soon.—**Hal Seykota**, Secretary, 1603 Calle de Primra, La Jolla, CA 92037

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John G. Burr, professor of chemistry at the University of Oklahoma, writes that he is now doing research in coal chemistry and editing a book, *Chemiluminescence and Bioluminescence Today.* He feels as though there are still lots of years left before retiring. The last of his seven children graduated from college last year—two and one-half Ph.D.'s, one M.D., and several M.S.'s. . . . **Charlie Fitter** reports that they no longer live on their ketch and have returned to Rochester, N.Y., spending summers on the St. Lawrence in the Thousand Islands area. He keeps busy with activities in a small travel agency called Vacation Station. . . . Elizabeth and **Dave Hoisington** are enjoying semi-retirement on San Juan Island. The wildlife visible from their living room ranges from whales to bald eagles. They are planning a cruise to Alaska in the near future. As professor emeritus of the Naval Post Graduate School in Monterey, Calif., he presents education courses in electronic warfare which provide the opportunity for travel in the U.S. and abroad. As a result, he visited in Europe and South America during this past year.

Peg and **Bill Kather** celebrated their 40th wedding anniversary last October. He has recently added a second career as a stock market investor to his primary task of operating a chemical and plastics consulting business. . . . **Norman Laschever** writes that he is still with RCA Automated Systems, Burlington, Mass. He serves on the general manager's staff as principal scientist. His job involves consulting, trouble shooting, and selected "leading edge" assignments. He is considering retirement in the next year or two. . . . **Norman Klivans** is planning a Class of 1940 "get-together" on June 10 and 11, including several tables at the Pops on Thursday evening, June 10. Please drop him a line if you are planning to attend. His address is 3123 Bremmerton Rd., Cleveland, OH 44124.—**Donald R. Erb**, Secretary, 10 Sherbrooke Dr., Dover, MA 02030, (617) 785-0540

Victims in Marin County

The home of **Martin** ('40) and **Jean** ('41) **Rosse** in Strawberry, California, was destroyed in a mudslide early in January. Their lot is now unbuildable, and both are uninsurable losses. Martin Rosse is seriously ill with cancer, and their financial resources were depleted; he was described in Marin County newspapers as one of the community's "most beloved leaders." Both Martin and Jean—she is the daughter of Frederick S. Fassett, long-time dean of residence at M.I.T.—hold M.I.T. degrees in architecture.

Friends and neighbors have established a fund-raising effort, and contributions may be sent to the Rosse Trust Fund, care of the Bank of Marin, Box 153, Mill Valley, Calif., 94942.

42 40th Reunion

Save these 1982 dates: June 10, *Tech Night at the Pops*, and June 11, *Technology Day*, plus before and after for our own gala reunion activities.—F.H.B. (**Kenneth Rosett**, Secretary, 191 Albermarle Rd., White Plains, NY 10605)

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Once again, **Bill Thurston** is newsworthy. He wrote an article for the Summer 1981 issue of *Sloan Management Review* about how a new marketing approach transformed and revitalized his 60-year-old company, GenRad, Inc.

Charley Swet reported by telephone that three years ago he left the Department of Energy, where he was managing a program for thermal and thermochemical storage. He is now a consultant in Mt. Airy, Md., specializing in solar and other "gentle" technology. He works with applications in developing countries, such as India, where solar cookers with storage might replace burning wood and animal dung. Charley is active in the American Friends Service Committee. He is proud of five children and two grandchildren, with one son described as a "fine, starving artist." Charley looks back fondly on the 25th Reunion in 1968, and hopes he can make it to the 40th.

Sherman Sackheim is a "semi-retired, full-time" realtor in sunny Clearwater, Fla., doing the hardest work he's ever known, and loving every minute. He's been at it since 1977, handling both residential and commercial property. The Sackheims have three children and no known grandchildren. Son Neil is an advertising executive in Houston; son Andrew handles the engineering at an Atlantic City TV station; and daughter Stephanie is a manager for a drug chain. Sherman lives on the shore, has a boat, and considers that life is full and good. He does plan, however, to tear himself away long enough to attend the 40th Reunion.

We are informed by Elizabeth Gallatin Baybut that **Albert F. Gallatin** is no longer on this earth. Albert's last known address was Kittery Point, Me., and the date of his death was sometime in 1979. Beyond this we have no further information.

I enjoy talking with you on the phone, but notes and letters are better for transmitting the news. Please write, or at least get your name in the paper.—**Bob Rorschach**, Secretary, 2544 S. Norfolk, Tulsa, OK 74114

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Spring has officially arrived and has brought forth all the activities associated with this season. Can summer vacation plans be delayed much longer?

Flap Facts: **John (Jack) B. Breymann III** regretted missing the fall telethon and was looking forward to participation in the spring telethon. . . . **Will Rodemann** votes for our 40th Reunion at Martha's Vineyard. . . . **Jose M. Aguila, Jr.** writes that he "bought a Grand Banks 49 trawler type yacht" and that his wife Rose Mary and four sons (8, 10, 12, 14) joined with him in cruising the Caribbean from Miami to Venezuela, stopping at many of the familiar islands along the way. They were joined by several more people for different sections of the trip. "It was quite an experience for all," says Joe.

Joseph A. Alexander writes that he had been elected president of Newton Taxpayers' Association and was subsequently appointed executive director. Joe has his own business in Newton, Mass., as business consultant and business broker. His son Steven recently received a master of management degree from the Sloan School.

Tech Talk of December 16 reported that the efforts of the Admissions Office in stepped-up recruiting activities this past year resulted in a 21 percent increase in "early action applications." This increase included a 23 percent increase in the number of women applicants. In December, M.I.T. offerred admission to 288 applicants and expects to offer admission to 1,800 applicants to create a freshman class of 1,000 students in the fall. Thanks to each of you who helped, actively and passively, in the nucleus of the '86 Class of M.I.T.

It's still not too late for your suggestion for the location of our 40th Reunion in 1984. I'm easily reached by mail and will transfer your wishes to the ongoing reunion committee.—**Melissa Teixeira**, Secretary, 92 Webster Park, West Newton, MA 02165

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To begin with, I'd like to express my personal gratitude to **Russ Dostal** for his 20 years of loyal service as class secretary. That's a commendable record, and I hope you'll drop him a note of heartfelt thanks. His address is (still): 18837 Palm Cir., Fairview Park, OH 44126.

For myself, I ran into Russ at the 35th and offered to shoulder the burden, if/when he was willing to call it a day. Darned if word didn't get back to **Jim Goldstein**, our new prez, who called in November to see if I was serious. No, I hadn't had too much bubbly when I volunteered, so, in short, here I am. To append what Russ wrote about me in the December 1981 Notes, Bettie and I live in comfortable poverty in S. E. Denver, offering room and board to assorted transients including my younger son, Chris, and to any '46 travelers who happen through Denver. And in case you missed it, gourmet cooking is one of my hobbies. Just thought you'd like to know.

The *real* news is that **Stu Edgerly** was appointed secretary of the Florida Department of Commerce by Governor Bob Graham in November. He urges us M.I.T. grads to spread the word about business and tourism opportunities in Florida. Stu, who resigned as president of Cordis Dow (Miami) in October, will bunk down in Tallahassee, while Jean, his wife, will maintain "family headquarters" at their Miami home, at least for a while. They live at 12100 S. W. 64th Ave., Miami, FL 33156. Drop in when you're down that way. Jean plays mean tennis.

Don Hurter's name showed up in an October *New York Times* article relative to the "Future Fuels Challenge Rally." Don, who heads A. D. Little's automotive technology unit, was quoted as saying: "People (automakers) have been working on what outsiders may consider the minutiae of the engine, such as the shape of the combustion chamber, at an unprecedented level. They don't have time for Wankels, etc. They are concentrating on what they know most about." Hmmm. Have to think about that.

And speaking of autos, got word at the 35th that old friend, **Jim Chabot**, took early retirement from Ford Motors in the fall of 1980. Knowing Jim, though, he's probably still plenty busy. He still lives in Birmingham, Mich.

Concerning this column, I've been doing assorted newsletters for 20 years, so this one holds no terrors. The only thing that troubles me is the four months' lead time between copy deadline and *Review* publication. So I ask you all to "be patient." If you'll send me your info, I'll be most happy to fit it in. We plan to make a concerted effort over the next few years to improve class communications. Your contributions are part of it! Keep in touch.—**Jim Ray**, Secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

47 35th Reunion

REUNION CALL TO COEDS. **Carol Tucker Seward** suggests that for our 35th we try for a large turnout of women. "For those who haven't been back to the Cambridge area recently, it would be a chance to see the changes (and many for the better) in Boston and surroundings."

Now, the women will have received a separate, individual mailing on this before this issue comes out, so the rest of you out there can appreciate with what subtlety I am letting you men know that we are coming, in force. Also, Carol's quoted comment applies to everyone. Come and see what they are doing to Kendall Square! (But don't come by subway, you might get lost.)

Walter Rotman writes: "I have retired from the Rome Air Force Development Center (U.S. Air Force) in October 1980 and am currently working at the M.I.T. Lincoln Laboratory on Military Satellite Communications." . . . In 1972, **Bob McBride** established Remac Associates for marketing consulting, primarily for companies that sell technical products to industrial or construction markets. He says the business has been very successful and lots of fun, with travel all over the U.S. and occasionally to Europe. Clients range geographically from Wisconsin to Germany. Daughter Jann is a system engineer for IBM in Denver; Nancy, also in Denver, is an industrial audiologist (plus) for Occupational Health, a subsidiary of Coors beer; and Bob is a financial analyst for Amax in St. Louis. . . . **Henry Lee**, Pasadena, is active as president of the company he founded, Lee Pharmaceuticals (AMEX/LPH), manufacturing dental materials, cosmetics, and pesticides (two come-hithers and one go-away). On his new love, microcomputers: "Always hated the arithmetic involved in chemical engineering, but now I can really systemize all two dozen variables in a material balance or design problem, etc., without having to fight for time on the company's mini. It's great for statistical forecasting, too. Using my TRS-80 as a word processor, I have cleaned up four book manuscripts that were way over due, too." (Widens the readership.)

Sidney Smith, B.S. and S.M., Course X, and one of the few M.I.T. Ph.D.'s in psychology, stopped by to see Henry a while ago. Sidney is a leading computer psychologist with Mitre Corporation. . . . Grace and **Donald Dean** visited the Fiji Islands, New Zealand, and Australia in 1980. He says, "It's another world down under, and one to be reckoned with." The peripatetic Deans visited China in 1979 and again in the fall of 1981. This time they went via London, Moscow, Irkutsk, Siberia, then by train south through Mongolia to Ulon Bator (capital), across the Gobi desert to Datong, China, and finally to Peking. . . . **Vince Haneman** is dean of engineering at the University of Alaska in Fairbanks. He is also president of the American Society for Engineering Education. Shortly after his retirement from the Air Force Reserves as major general, he was awarded the Distinguished Service Medal for services to the Deputy Chief of Staff—Research and Development and Personnel. . . . **Harold Raiklen** is still with Rockwell International Aircraft, heading Strategic A/C Systems. He says, "Hello, everybody, including **George Welti** and Boris Miller, '41."

Harl Aldrich, co-founder and president of Haley and Aldrich, consulting geotechnical engineers and geologists, has been elected to the M.I.T. Corporation for a five-year term. Harl is a founding annual member of the Corporation Visiting Committee for the Department of Civil Engineering. He has played an active role in alumni affairs for more than 15 years and in 1976 received the Bronze Beaver Award ackowledging his service. . . . The Bank of New Hampshire, Manchester, has named **Philip Labombarde** a director. . . . Flash from the City of Tacoma, Washington, Department of Public Utilities: "Effective June 1, 1981, **Robert F. Athow**, principal professional electrical engineer, will be appointed chief electrical engineer in the Systems Engineering Section." One commodore (U.S.N. Ret.) who doesn't mind becoming a chief. . . . **Walt Weeks'** son Hal, H------d, '77, completed the academic work for his doctorate in evolutionary (no initial r, please) biology at Cornell last May. Daughter Meg graduated from William and Mary with plans to work for a year, then return to school for an M.B.A. Walt is still with Remington Arms/Dupont. He says that he and Bet are still getting used to a quiet home.

I hope you have all sent back your reunion reservations by now. See you there!—**Virginia Grammer**, Secretary, 62 Sullivan St., Charlestown, MA

48

M.I.T.'s Endicott House, a lovely mansion in Dedham, was the scene of another mini-reunion attended by 15 classmates and their "whofs" (wife, husband or friend). We were entertained by singers including a solo by **Milton Slade**'s daughter Debbie, which we all enjoyed and which brought beaming smiles to her parents' faces. **Graham Sterling** conducted a brief business meeting, and **Don Noble** reported on some options for our 35th Reunion in June 1983. I suggested that we ask **Phil Macht** and **Bob Abelson** to write a mini Tech Show for the event, and I feel sure we will convince **Bill Katz** to play the music.

Dave Finnegan has a new woodworking venture. He has formed a company to fabricate custom items like doors, fireplace facings, archways, and restoration mill work. He has reproduced items for several restoration projects. . . . **Ken Brock** writes that he and Ann have been in Pleasantville, N.Y. for over four years. Ken is director of development at the New York Hospital, Cornell Medical Center. New York Hospital is the second oldest hospital in the country (pre-Revolution!). Ann has her own business—with a partner—doing commercial editorial and graphic design work: brochures, newsletters, logos, corporate image, etc. All classmates are reminded: if you want to enhance your image by having a New York agency, here's the chance—call Ann! Ken and Ann's son, Charlie, is a junior at Haverford and has found his niche in liberal arts. He had a year at M.I.T. and found the academics easy but dull! So, he took a year off to regroup and now is on top of the world. Their daughter, Lee, is a sophomore at Connecticut College, New London (and also on top of the world). Ken hears talk of retirement from our group. He wonders if we have a classmate who's specializing in retirement planning, particularly with a formula where net retirement income is higher than when one is working. If so, please send your name—you have a client.

Sidney Crook retired in May from Avco Systems Division, where he worked on the MX missile's re-entry system. He and Dotty moved back into the house where he was born, on the shore of Lake Sunapee. He spent the summer sailing in Star boats and the fall traveling in Great Britain. Sidney's comment: "I should have retired sooner."

After graduation, **George Keller** joined Cal Standard (Chevron) as a refinery design and construction engineer. After 34 years, he has parlayed that $310-a-month position into the chairmanship of the nation's fourth largest oil company. In an interview with the *Los Angles Times*, George commented about his personal role and Chevron's plans. The company drilling successes have left it with plenty to do for the present. George said, "If I did nothing other than not get in the way, [Cal Standard] would move through the 1980s in very nice condition. I feel I should be concentrating on the turn of the century and beyond."

George openly condemned Mobil Oil's bid for Conoco. He described himself as "distressed" over what such a merger would have done to Big Oil's image in Washington, D.C. George's attitude is a natural outgrowth of a policy begun by his predecessor who in 1974 banned "no comment" as a response to public inquiry about company operations. Good luck, George.

Any classmates concerned with the residual value of computers may find it useful to obtain a complete copy of **Sonny Monosson**'s remarks to the New York Industry Analysts, presented originally in May 1981. Sonny foresees an intelligent terminal with 100 megabytes of storage hooked into a vast computer complex with all types of data bases and libraries. He also predicts a marked reduction in sales of used computers since used computers may not be much of a bargain if prices of new computers dive.Sonny announced that he is diversifying his business into computer terminal leasing, used software, and publishing. . . . **Les Ackerman** read in the November/December 1981 issue of the *Review* that **Harold Knapp** joined our class. Les, like Harold and **Bill Katz**, entered M.I.T. in 1941 but graduated in 1948. He recalls watching Harold (now a Boston Marathoner) run on the South Byfield Rd. in Newburyport, Mass. He also remembers watching Bill's fingers running over the ivory keys. Les has been based in Dallas for 35 years, but he spends a good deal of time in Big Sky, Mont. He has a Montana professional fishing guide's license (fly fishing). . . . **Herb Kindler** received his Ph.D. from UCLA and now provides training programs to corporations (nationally) in effective leadership, creative problem-solving, managing differences, and the self-management of stress. He is professor of management at Loyola Marymount University in Los Angeles. His current research is assessing the influence of stress level on problem-solving effectiveness. Herb's son, David, graduated from M.I.T. in 1978 and is now in advanced technology at Polaroid in Cambridge.

Gordon Pettengill spent the last academic year on sabbatical leave in Sydney, Australia, where all hands enjoyed new experiences in a new land. . . . **Roy Amara** is president and senior research fellow of the Institute of the Future in Menlo Park, Calif. After his Ph.D. at Stanford, he joined SRI from 1952 to 1969 where he served as senior research engineer, manager of the Systems Engineering Laboratory, executive director of the Systems Science Division, and vice-president of institute programs. Recently, his views on management in the eighties were published in *Technology Review* (April 1981) and in *The Minority Engineer*. . . . Thanks for your mail.—**Marty Billett**, Secretary, 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8963

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Peggy and **Jack Fogerty** celebrated their 25th anniversary in London, and preferred their March "off-season visit" because they "saw London and not people." . . . **Chester M. Patterson** envisions a cruising retirement in his ketch. In the meantime, he and his eldest son are pulling their multiple companies through the present economic slump. These include plastics, aluminum fabrication, tire recapping, agricultural machinery, industrial machinery, chemicals, and aluminum distribution.

Our sympathies are extended to **Dave Hardin**, whose wife Diane passed away last August. . . . **Richmond Perley** is manager, new products, Kaman Aerospace Corp., and after many public positions, was running for Town Council in Glastonbury, Conn. Unfortunately, I have no news as to the electoral results. We hope he won. . . . **Ferdinand Mikel** retired from the Naval Air Systems Command Propulsion Division. He is still consulting on aircraft engine development and also represents MSTE, an English manufacturer of currency printing presses. I wish I had one! . . . **William Hutchinson** has retired to Jacksonville and is actively involved in the local chapter of the English Speaking Union. . . . **Clyde Brindley** is now in Tyler, Tex., teaching medicine and researching the drug treatment of lung cancer. Clyde is an associate clinical professor at the Texas Health Center.

Marge and **Dave Moore** are still in Derwood, Md., and still excellent hosts, as your secretary found on a snowy December night. Dave is now deputy director of the Building Technology Division of HUD. Both Dave and Marge are very active leaders in the Rockville Presbyterian Church. Dave also reported on three other classmates: **Otto Kirschner** is now in the D.C. area representing his long-time company, Boeing. . . . **William Stoney**, with NASA for many years, is now deputy director of Atlanta's Southern Solar Energy Center. . . . **Robert Griggs** remarried last November. His bride, Betty, was a long-time acquaintance. Both have continued their individual professions: Bob, a lawyer, and Betty, her own real estate business in their home in San Juan, Puerto Rico.

Please add me to your Christmas card/letter list so that we of 1949 can keep up to date with each other.—**Paul E. Weamer**, 331 Ridge Meadow Dr., Chesterfield, MO 63017

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Mariano A. Romaguera reports that he is entering into a contract with the United Nations Environmental Office for consultation with the government of Trinidad and Tobago. The work will be on environmental policies and installation of air cleaning equipment for industries. . . . Corning Glass Works announced the appointment of **Thomas Howitt, Jr.** to director of purchases, corporate purchasing. Tom joined Corning in 1950 and, since January, was corporate director, strategic and engineering purchases. . . . **Richard H. Holmberg** is still at International Signal Corp. in Lancaster, Pa. He has become an active duplicate bridge competitor and has met many alumni through the game. Dick has two sons living in California and one married daughter living in Lancaster. Dick also wishes more of the Class of 1950 alumni would drop a line to the *Review*. He enjoys reading of the activities of everyone.—**John T. McKenna, Jr.**, Secretary, One Emerson Place, Apt. 11H, Boston, MA 02114

52 30th Reunion

Our 30th Reunion is just two months away. If you have not already made plans to join us, please reserve the space on your calendar for June 10-13, Thursday through Sunday, to come back to the M.I.T. campus on the Charles and see the changes that have been made since you left. We plan a traditional M.I.T. Night at the Pops with refreshments before and after on Thursday night. Friday, following Technology Day, we will have an evening dinner dance in the Museum of Transportation. On Saturday we plan a tour of historic Strawberry Banke in Portsmouth, N.H., followed by a clambake on the beach next to Wentworth-By-The-Sea. Thirtieth reunions come only once. We will be glad to see you there. Come. Bring your spouse and family and see how Tech and your old classmates are making out.

Michael Lubin writes that he retired from the U.S. Air Force in August 1980 and is now with Perkin-Elmer ETEC, Inc. . . . A note from **Richard H. Daly** says, "I have moved to a fully restored Victorian house, vintage 1850, in Milford, Mass. with my wife Laurie. We had a picture-perfect Victorian wedding in our garden in our new home. I have reached the 25-year mark at Raytheon and have a signal processing department at their Wayland plant."

And now a few words from our classmates in the oil business. **Werner Kahn** continues as resident representative of Gulf Refining and Market-

ing Co. for South America.He is now in his 25th year with Gulf and spends most of his time traveling in Latin America. He has also been assisting the Alumni Association in getting new students acquainted with Tech. . . . On July 1, 1981, **W. P. Chandler** was appointed to a new position, manager, corporate projects, at SOHIO (Standard Oil of Ohio). He is responsible for negotiating and implementing major corporate diversifications including acquisitions and joint ventures. Mr. Chandler was also elected vice-president of SOHIO Commercial Development Co. . . . **Sergio F. Valdes**, who is with Aerospace Corp. in El Segundo, Calif., notes that he had a stroke on March 28, 1981, which paralyzed his left leg and arm. "Am rapidly recovering. Now ambulatory with a cane; my auto with automatic transmission. Limited use of my left arm and hand. I'm told complete recovery possible within the year. I couldn't have made it without my wife Dolores."

Two of our classmates who are General Electric employees have been in the news lately. **Michael S. Adler** has been named manager of the Power Semiconductor Branch of General Electric Research and Development Center in Schenectady, N.Y. He will direct the activities of a group of scientists and engineers involved in the study and development of power semiconductor devices and integrated circuits. These devices are used in electrical equipment and in consumer products where power conditioning circuits are employed, including sophisticated drive circuits for motors, AC/DC conversions, lighting, and electric cooking. Dr. Adler is a native of Detroit, Mich. . . . **H. Stephen Spacil**, who is a General Electric Co. scientist stationed in Tokyo as a scientific observer, was recently quoted on the front page of the *Wall Street Journal* (December 1, 1981). In the article, Steve comments that many large Japanese companies have labs that do nothing but design production equipment for their own factories.

Edward S. Lipinsky of Columbus, Ohio, has been cited as one of the 1980 Battelle patent holders. His patent is "a pharmaceutical dosage system in which drugs are deposited on a web of edible polymer and fabricated into a controlled release form." . . . **William McKinley** of Harness Lane, Sudbury, Mass., died Monday, November 2, 1981, in a drowning accident on Cape Cod. Bill was an executive for 27 years at the Raytheon Co. plant in Wayland. Bill was born in Michigan and received his S.B. in electrical engineering. During the Korean War he served with the Air Force. Later he did graduate work at Northeastern University, receiving his master's degree in 1956.—**Arthur S. Turner**, Secretary, 175 Lowell St., Carlisle, MA 01741;**Richard F. Lacey**, Asisstant Secretary, 2340 Cowper St., Palo Alto, CA 94301

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The rascals did it again! Connie and **Jim Brown**, the youngest grandparents at our 25th Reunion, are grandparents once more. Their oldest daughter Judy gave birth to Virginia Anne Bryan on October 18, 1981. Congratulations are also due to their second daughter Ginger, who graduated from Case Western Reserve Law School in May, was admitted to the Ohio Bar in November, and is now a junior associate at Thompson, Hine, and Flory in Cleveland.

We received sad news on the death of two of our classmates in California. Maureen (Mrs. **John**) **Maris** advised us that her husband died last February in Sunnyvale after a long illness. **Dick Nilson**, who lived in Placentia, Calif., died on August 13, 1981. Our heartfelt sympathies are extended to Maureen and to Jane Nilson.

I noted with deep personal sadness the death, also on August 13, of Austin Whillier in Johannesburg, South Africa. Although not a member of our class, Austin was the star fullback of the M.I.T. Rugby Club during our student years. Those of us who were lucky enough to have played rugby with him came to respect and admire him for his athletic prowess and his gentlemanly demeanor. He was a poineer in the area of solar energy utilization and a world-renowned expert on heat transfer. I extend my condolences to his family.—**William Combs**, 120 West Newton St., Boston, MA 02118; **John Kiley**, 7 Kensington Rd., Woburn, MA 01801; **Louis Mahoney**, 52 Symor Dr., Convent Station, NJ 07961; **Dominick A. Sama**, 28 Chestnut Hill Rd., Groton, MA 01450

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At this time of year many of us pay taxes. Of course, for some of us it's not all that personal a matter. Over drinks at the Bay Club, our accountant informs us that the year-end straddle didn't work, the IRS disallowed the gypsy moth farm as a shelter, and that the court ruled against us for the 1978 beefalo franchise, so this year we'll probably have to pay something.

However, for us in the trenches, it's different. Nightly there is a vision of a damp cold cell in Danbury; none of those easy tours making furniture in Allentown, reserved for the politically prominent. A van arrives to take away the bicycles, clock radios, and the dog as partial payment of the penalty for underestimating. Kafka copied from the training manual of the gimlet-eyed mindless misoneist who will not grasp, no matter how often told, that you *do* have two children attending expensive schools, even though their names are Tweety and Rover. The purple Lincoln with the fluffy white Norway rat upholstery was a business expense, needed for status just as much as a corporate jet. And everyone in Miami needs a small boat, preferably a Cigarette. And all this for a pittance. What with state income tax, and the real estate tax, and the sales tax, and the mortgage, and the tuition, the money transfers to Switzerland have gotten so small that the director-general of the bank no longer calls daily. So much for diversification; back to the news.

Last year, **John M. Ackley** was named president of Transidyne General Corp. Located in Ann Arbor, Mich., the company manufactures medical electronics systems, including fetal monitoring equipment. . . . Major General **James A. Abrahamson** has been named associated adminsitrator for NASA Space Transportation Systems. He assumed the duties on November 1, 1981, at NASA headquarters in Washington. Previously he was deputy chief of staff for systems at the Air Force Systems Command headquarters. Selected as an astronaut in the Manned Orbiting Laboratory program, he served there from 1967 to 1969. He then served on the staff of the National Aeronautics and Space Council in the Executive Office of the President. In 1976 General Abrahamson became the director of the F-16 fighter program at Wright-Patterson Air Force Base in Ohio.

Allan Boardman continues his career as a manager at the Aerospace Corp. in El Segundo, Calif. After 18 months as director of the Aerospace Navstar Global Positioning System Program Office, he was promoted to general manager of the Electronics and Optics Division. His wife Lina is about to receive her second master's degree. The first was in gerontology, while this one is in business administration. Their oldest daughter Rebecca is enrolled at UCLA. . . . **Tom Thliveris** is now a vice-president of Fairburn Associates, Inc. in Phoenix, Ariz. . . . Among his many responsibilities, **Russell Meyerand** has been named an incorporator of Manchester Memorial Hospital, in Manchester, Conn. Russ is vice-president of research and development for the United Technologies Research Center.—Co-secretaries: **Allan C. Schell**, 19 Wedgemere Ave., Winchester, MA 01890; **Marc S. Gross**, Winding Road Farm, Ardsley, NY 10502

57 25th Reunion

Save these 1982 dates: June 10, *Tech Night at the Pops*, and June 11, *Technology Day*, plus before and after for our own gala reunion activities.—*F.H.B.*(**Fred Morefield**, Secretary, Shared Medical Systems, 650 Park Ave., King of Prussia, PA 19406)

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This column, written and scheduled for the February/March issue of the Review, *was inadvertently omitted. The editor offers an apology.*

Let me start this month's column by thanking **Phil Richardson** for taking over the notes for January. Not only was it a pleasure to be relieved of the responsibility for a month, but Phil's topic and message was quite timely. We are more than halfway to our 25th, and all pledges and contributions are vital.

Coincidently, the day after Phil submitted the column for me, I received a letter from **Earl J. Rogers**, Course II (it seems to me that over 50 percent of the notes I receive come from Course II grads). Earl's note was interesting for three reasons. First, it contained a release announcing his promotion to chairman of the board and CEO of Precision Monolithics, Inc., a semi-conductor manufacturer located in Santa Clara, Calif. Second, it contained an analysis of contributions to the Alumni Fund from the Classes of 1954-1964, inclusive.Our class placed third in his ranking, behind 1956 and 1962. Earl's comment: "Those guys are either more successful or less stingy than we are. Which is it?" Third, Earl included several personal comments. His wife of 26 years, Bonnie, has finally taken up golf and is director of their church choir. Earl has been playing in many Pro-Ams recently, with some nationally'known professionals. Son Brad is a junior in high school and an avid jazz and big band drummer. Daughter Caryn is a junior at the Baylor School of Nursing in Dallas.

Robert E. Brooker, Jr., Course XV, has been appointed president of the newly formed NL Industries information services group, a petroleum services and equipment company. He was formerly a vice-president of Cummins Engine Co. . . . Witco Chemical Corp. has formed an oil and gas division and has appointed **Gerald Katz** as corporate vice-president and general manager. Gerry received his S.B. and S.M. degrees in Course X, before traveling upstream for an M.B.A. at another well-known Cambridge landmark. . . . **Gerald L. Schroeder**, Course V, writes that he has been selected by UN-FAO to advise the government of the People's Republic of China on recycling agricultural wastes in order to reduce or eliminate the need for supplied grain and animal meal feeds. The assignment includes two months, February and March, in mainland China. He adds, "Our four children keep Barbara and me busy."

Ron Rosenberg, Course II, writes that he continues to hide out in academia at Michigan State University where "the major virtues are a new Center for Computer-Aided Design and a wonderful family life; the minor defects are the weather and the football team." Ron will extend a warm welcome to all M.I.T.ers who pass through Lansing. . . . **Thomas J. Healy**, Course VI, has been appointed vice-president for engineering at Dynisco, a manufacturer of transducers and related instrumentation. Dynisco is located in Norwood, Mass. Tom, a member of the Instrument Society of America and of IEEE, lives in Millis, Mass., with his wife, Barbara, and their four children. . . . **Robert W. Dix**, Course II, with MITRE since 1961, has been named department head of Strategic Systems Engineering at the MITRE Corp. Bob, Gretchen, and their sons, Wayne and David, live in Lexington.

Anyone reading this column with the least bit of care, might get the impression that I am pushing Course II. Quite the reverse—it is pushing me. It just so happens that they are almost the only alums sending me something to include in this column. I'm Course XV and will soon start to invent classmates and news in order to raise our banner. So c'mon, anybody.—**Larry Laben**, Secretary, 310 Rockrimmon Rd., Stamford, CT 06903

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We have about 200 responses to the 20th Reunion questionnaire, and I have spent a little time getting the results together. When we get a home

computer (in about five years), I'll be able to make more elegant conclusions. Now, I have to give you just percentages and raw data. The first section delt with our memories about M.I.T., out of date though they may be. Seventy-eight percent said they would choose M.I.T. again. That corresponds to 68 percent ten years ago and 77 percent when we were freshmen. As you may recall Lila Sussman and some of her associates were hired by the Undergraduate Association to find out why freshman year was so hellish back in the 1950s. These sociologist spent their time asking questions of our class in 1957 and came up with conclusions that, in retrospect, led to the easing of freshmen year requirements and grades. Anyhow, it is interesting to compare that long-ago data with what people say these days.

Getting back to the answers: more people would encourage a son (79 percent) to go to M.I.T. than a daughter (57 percent). That is about the same as ten years ago. There followed a section in which people listed things they liked and thought were important, or not important, about M.I.T. The academics won, hands down—we still remain "tools." The ambience of Cambridge didn't rate high with most people. That reversed the feelings when we were freshmen. People liked Cambridge but didn't think the heavy reputation of the faculty or the curriculum was very important. Ten years ago people were pretty cynical about how M.I.T. had helped them in their careers. About half the respondents said that the diploma was a good credential rather than a symbol of a good academic preparation. It opened doors. We asked people what their course number was—nearly every one remembered correctly.

After graduation, three-fifths went off to graduate school but nearly 90 percent eventually wound up in some graduate program or other. Fifty-eight percent ended up with an advanced degree, mostly Ph.D. or M.S.; 6 percent are lawyers, 5 percent M.D.'s and 13 percent M.B.A.s. Looking back at their grades, respondents thought, on the average, that they were average (which is reassuring). They recall putting in 28 hours per week at the books which corresponds with what people said at the time. Classmates were asked if they are happy now and how they remember feeling in the past (on a scale of 1 to 5). Memory stated that people were 2.5s as freshmen but have been getting happier since. Though not lobotomized, we think of ourselves as happy these days.

One section delt with vital and not-so-vital statistics. Eighty-two percent of the class is married now. That's down from 85 percent ten years ago. Fourteen percent are divorced. There is one widower and 4 percent say they are still looking. The rest, presumably, remain confirmed bachelors. (One exception: one class member has a gay marriage.) Nine percent of the class has been married twice. No one has been married three times. These marriages average a yield of two children although one came up with eight kids (and claims to be happy with them). Only about 20 percent of the married couples want more children (2 percent want fewer). In just over half of the marriages, the spouse also works (generally part time). Most (85 percent) own their own home with a value ranging from $34,000 to $900,000 and averaging $157,000. Mortgage and taxes cost an average of $565 per month, and the house is generally in a suburb. In this house is a closet containing between 0 and 40 suits (usually 6) and between 0 (!) and 55 (average 6) pairs of shoes. There is some controversy as to whether sneakers and joggers rate as shoes. The M.I.T. graduate occupants of these houses spend less than an hour a day in front of the TV (that's all they admit to) with the *Muppet Show* being the only program people actually admitted to watching. Sleeping goes on for 47 hours a week—the rest of the time with family or unaccounted for. Going out is a minor part of our lives. People see about one movie a month and hardly ever go to any other kind of performance. M.I.T. graduates don't seem to be junkies, although 38 percent say they have tried marijuana—none have hit heroin. Very few tried LSD or cocaine. Tennis is the most popular sport (44 percent) followed by jogging, skiing, and sailing. Poker and chess come in further down the list.

In the crime arena nearly 10 percent admit to having cheated on taxes but only 7 percent have been the victims of a mugging. Two of the muggings were at M.I.T.! Eighty-one percent feel that people are basically honest.

Non-professionally we read four magazines each month, eat out at a restaurant four times each month, and get invited to friends for dinner only once a month. That is fair since we invite them over only once a month. Since we are not very active, socially, we have plenty of time to read, averaging a book and a half each month. Some people have even more time and claim to read 25 books each month! While doing all this reading, we must nibble since 40 percent are overweight, nearly all of whom have tried to diet. About a quarter of the class used to smoke cigarettes but have quit. Only 9 percent smoke now—mostly cigarettes—but one says he smokes three "joints a day." There are a couple of cigar and pipe smokers, but no one admits to chewing tobacco.

Outside the house, half the class are active in community affairs doing things like Boy Scout leadership, YMCA, and church activities. Thirty percent are active church and synagog attendees. Another 30 percent show up on holidays. Three percent are "born again," while 42 percent never attend services.

Finally, nearly 60 percent think they are "very attractive." There is a lot more to cover—career, politics, and other aspects of our lives. I will get to them next month.

I look forward to hearing more about your lives and loves. Please keep me and the rest of the class informed as to your victories (and defeats). We are interested.—**Andrew Braun**, Secretary, 464 Heath St., Chestnut Hill, MA 02167

62 20th Reunion

Bardwell C. "Bojey" Salmon writes that a year ago he left Honeywell, Inc., where he was a vice-president, and joined a small start-up company in Boulder, Colo. Now he is vice-president of marketing for Prolink Corp., which deals with office automation via a local network system that integrates data, word, and voice processing, all over the same cable. Because it is an industrial first, he says it is as educational and time consuming as his four years at M.I.T. . . . **Donald W. Horner** has become the fourth member of our class here in Champaign-Urbana. He is now vice-president, systems, with Colwell Systems, Inc. . . . **Steven J. Brams** taught at Yale last fall in addition to his regular teaching at New York University. He has co-authored a book on election reform, *Approval Voting*, to be published this year. . . . **Stephen J. Warner** was recently named managing director of Merrill Lynch Venture Capital. . . . A press release from the University of Denver says that **Michael Levin** is now an associate research professor of mathematics and computer science. . . . **Modesto Maidique** has been named executive vice-president of Collaborative Research, Inc. in Waltham, Mass. He is responsible for growth planning in the research, development, and manufacture of biotechnology products. He was also recently appointed to the faculty of Stanford University where he will teach management of technical enterprises.—**John E. Prussing**, Secretary, 2106 Grange Dr., Urbana, IL 61801

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Slim pickins this month—you are getting uncommunicative in your old age. Just a news clipping and one envelope flap. **Charles S. Roberts** writes that he is head of the Interactive Computer Systems Research Department at Bell Labs, Holmdel, NJ 07733. His department does work on new software and hardware for data communications and information retrieval. . . . A news clipping from the Beverly, Mass., *Times* reports the participation of **William Vachon** in the Wenham Museum's program on energy economies. Bill gave lectures on wind technology and other alternative energy systems. He is a member of the energy systems technology unit in the Engineering Sciences Section of Arthur D. Little, Inc. His work has centered on the thermal design and testing of components used in space flight, and testing of equipment for measuring oceanographic data.

Since I need some material for filler this month, I will devote a paragraph to my own adventures in the last year. After ten years with Nucleonic Data Systems, I left last April and formed a new company, Gamma Instruments, Inc. We are building nuclear radiation thickness gauges for measuring the thickness of metal sheets and coils in steel, aluminum, copper, and brass. Our product has some unique technical features and is designed so that it can be produced very economically. This design has given us a significant price advantage over our competition, and we are attracting quite a bit of attention in the metals industry. Our first system should be installed by the time you read this column. We are cautiously optimistic. Any of you who need to measure metal thickness of flat rolled products please give me a call. . . . So much for the commercial—send me some material for this space.—**Mike Bertin**, Secretary, 18022 Gillman St., Irvine, CA 92715

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Greetings, after a long hiatus. I regret that we (Marlene shares the blame of failure equally with taking the credit for successes) have missed a few issues and can only partially credit the lack of news as a reason. This fall has been particularly hectic businesswise and familywise, adding an extra level of activity to the usually busy fall months. We shall try in earnest to resume uninterrupted classwide communication, depending upon all of you, naturally, for interesting source material.

It is with much sadness that we must report the death of **Howard E. Kirkendall** on June 5, 1981. Howard was employed by IBM as an advisory financial analyst in the internal telecommunications business controls department. He is survived by his wife Sandra and two children, who reside at 317 Beechmont Dr., New Rochelle, NY 10804. Contributions to his memory may be made to the M.I.T. Alumni Fund, Room 10-120, 77 Mass Ave., Cambridge, MA 01239.

First, for this issue, we have some class heroes. **John McFarland** wrties that there are two items of note in his life. The first is his book, *The Exploding Frog*, 36 fables from Aesop retold by John, which is being published by Little, Brown and Co., in both clothcover and paperback. His other achievement, in his own words, is his escape, finally, from working for the U.S. Department of Energy as an economist. John indicates he is quite happy about both events. His address, should you be in the area, is 1015 West Howe St., Seattle, WA 98119. . . . We have also received a nice letter from **Mark S. Ain**, president of Kronos, Inc. Mark first reported the birth of a son, Joshua, to Lillian and him, last March (1981). (He has his priorities straight about which news is important!) He then proceeded to the good news about the rapid growth his firm has experienced and which he prognosticates for the future. In his own words, "Less than two years after shipping our first units, sales have climbed to the $4 million annualized rate and we have over 50 employees, including a number of M.I.T. graduates." Congratulations, Mark!

Next, we have some news release information. **Mark B. Barron** has been named staff executive, technology operation, for General Electric Co.'s industrial products and components sector. Mark, his wife Mary, and their three children are relocating from Camillus, N.Y., to Fairfield, Colo. Most recently, Mark, a 12-year GE employee, was manager of the solid state applications operation in Syracuse, N.Y., an arm of the company's corporate research and development center.

Now to the Alumni Fund envelopes, which are the backbone of our column and no small help to the Institute. Without these, we would have precious little information. **Edward L. Arnn, Jr.** is now

chief scientist at Hughes Aircraft in Culver City, Calif. His wife JoAnn has just become an interior designer. The Arnns have an 8-year-old daughter, Nicole. . . . **J. Crawford**, is manager of mechanical engineering for ADB-ALNACO, a small firm making airport runway lighting systems in Gahanna, Ohio. He is also busy refereeing soccer games for the local league, and trying to cultivate a small apple orchard in his backyard.

For our part, we had the unpleasant excitement of an unusual camp accident, seriously injuring Lewis' right eye. Though many of our summer plans were curtailed, cancelled, or altered, we have opted to discover some lovely "local" retreats, such as Ocean City (Maryland's seashore) and Host Farm (the Amish country in Lancaster, Pa.). Also, the accident to Lewis occurred after the entire family had an enjoyable two-week odyssey "touring" New Jersey, New York, and New England to attend a bar mitzvah, visit family and friends, and enjoy the Ogunguit (Maine) seashore.

On the business scene, a reorganization within ManTech has resulted in the formation of the Technology Group with yours truly in charge as the group vice-president. The fall, as ever, was replete with testing technology conferences, meetings, and seminars, causing me to journey to Seattle, Chicago, and Orlando (one conference was finally in Washington, D.C.!). On top of those trips, visits to ManTech offices in southern California, and now also Annapolis, in addition to "marketing" trips, have kept me hopping. January holds another western swing plus a couple of side trips to New York and New Jersey. By the time you read this, Marlene and I will likely have been to Germany and Greece (in March) for a mixture of business and pleasure.

Relative to more long range planning, George's bar mitzvah (next November) is proceeding smoothly, with hall, orchestra/band, and caterer selected. Flowers, photographer, and guest list are still in process. This year the boys will try an eight-week camp, in Maine, which belongs to a cousin of Marlene's. They are looking forward to it, and we are very pleased with their attitude in view of last summer's experience.

We look forward to hearing from you, classmates, by mail, by contribution (to M.I.T., of course), or by press release. Stay well and WRITE!!!—**Steve Schlosser**, Secretary, 11129 Deborah Dr., Potomac, MD 20854

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Between missing the last deadline and a small infusion of Alumni Fund envelopes and press releases, I seem to have enough material for a column this month. Surprise and Happy New Year. . . . **Greg Schaffer** sent me the family's long and interesting Christmas letter with lots of news. Some excerpts: Greg is a founder of a new company, Telmos, in the San Francisco Bay area (Silicone Valley). He brings his experience with analog CMOS design to the venture where he is working on a 50-nanosecond digital-to-analog converter. Greg and Suzy included some interesting photographs of Suzy perched 40 feet in the air while rock climbing at Pinnacles National Monument. Greg also reported lots of athletic news including a marathon in under four hours and a ten-kilometer race in under 40 minutes. . . . Lilli and **Tom Van Vleck** report the birth of a son, Jesse, in April 1981. They, too, have moved to the Bay area and are both working for Tandem Computers. . . . **Lew Green** is also in northern California. Lew and wife Jill live in Irvine with daughter Laura. Lew is vice-president of finance and administration at Southwest Engineering in Santa Ana, and Jill has recently returned to work as a technical writer for a software company. Lew reports that Linda and **Jim Steele** are neighbors in Irvine, and that Jim is in marketing for Beckman Instruments.

Returning to East Coast news, Edith and **Jon Addelston** are still in Newton, Mass., where they serve as co-presidents of the school attended by Rachel, 5, and Miriam, 8. Jon is now director of Advanced System Architecture at Wang Laboratories. . . . Irene and **Jeff Gertz** report the birth of a son, Nolen, last September 19. Nolen has an older brother, Bennett, 4, and the Gertzes are once again "enjoying" crying and diapers. Jeff is still working on air traffic control systems at Lincoln Lab. . . . **Don Yansen** has started a company, Interactive Video Systems, Inc. of Bedford, Mass., to build video analysis systems. . . . **John Larkin** became pastor of the Central Congregational Church in Orange, Mass., last October. John had previously been at the Lincoln Congregational Church in Lincoln, Maine. . . . **Martin Goldsmith** is associate clinical professor of radiology at Tufts Medical School and a radiologist at the Boston Veterans' Administration Hospital in Jamiaca Plain. Martin and Karen have sons Mike, 11, and Craig, 7.

John Edgar is on active duty with the Air Force as a lieutenant colonel on the faculty of the Defense Systems Management College at Fort Belvoir, Vir. He graduated from the Industrial College of the Armed Forces last June. . . . **Dick Nathan** is still manager of Battelle's Nuclear Technology and Physical Sciences Department with about 120 people doing research on nuclear materials, nuclear safety, probabilistic risk assessment, large lasers, optics, sensors, and xerography (wow!). . . . **Sharon Cutler Ross** is coordinating a faculty seminar on the history of science as a follow-up to a National Endowment for the Humanities summer seminar in 1980. She doesn't say which faculty and my records are old. Sharon is still fencing and enjoying "this area" of the country (Atlanta?). . . . **Cliff Weinstein** reports that he and Georgia had a son, Kenneth Allen, last July 2. Kenneth joins sister Dena, 7, and brother Jonathan, 4. . . . **Bill Roeseler** was chairman of Ancient Interface XI, an AIAA/SNAME sailing symposium held in Seattle last September 12.

Dave Nolan has joined the Adam Smith ad agency in Denver as vice-president/creative. Dave has received a fair amount of publicity himself as founder of the Libertarian political party. . . . **Steve Williams** has been named senior vice-president in the Planning Division of the American Stock Exchange. Steve has been with the exchange since 1972. . . . **Jim Falender** has been promoted to section manager for Elastomeric Materials Technical Service and Development at Dow Corning in Midland, Mich. He was previously a senior research specialist in silicone elastomers research. . . . **John Fadum** is working on a book entitled, *Black Holes, Superspace, and Alternate Universes*. He gave a lecture last September on the same topic in Hamilton, Scotland.

That's a little better. Keep trying. I try to make up details for skimpy fund envelopes by referring to **Ed Hoffer**'s and my index to the last seven years of columns. If I guess wrong, write and correct me.—**Steve Lipner**, Secretary, 6 Midland Rd., Wellesley, MA 02181

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Jim Deckert has a challenging hobby—he rebuilt a 1946 Piper J-3 Cub, a five-year project, and now flies the plane. . . . **Peter Thomas** is now a principal of the design firm, Sasaki Asssociates, and has been project director of a large condominium project for the firm in Key Biscayne, Fla. . . . **Dave Mundel**, who hosted part of our 15th Reunion festivities, served as chairman for the City of Boston employees United Way campaign. . . . **Robert Large** has been appointed director of engineering for Anaconda Industries. He and his wife Jane wrote to say they enjoyed the 15th Reunion. . . . **Martin Kaliski** is back in Boston as associate professor in electrical engineering at Northeastern after spending the prior year as a Fullbright scholar in Paris.

Paul Rudovsky received the 1981 Harold E. Lobdell Award for Distinguished Service to M.I.T., for his work with the Alumni Association. . . . **Alan Whitney** is currently a member of the research staff at the Haystack Observatory. . . . **Robert** and **Lewis Gaines**, now live in Allentown, Pa., where Lewis works in market development for Exxon Enterprises. . . . **Steven Weiss**, is a senior computer scientist with Comshare, Inc. He has been with them since graduation. . . . **Tom McDonough** has finished his first novel, *the Armageddon Effect*. He is teaching at Caltech and consulting to producers at Sci-fi Films. . . . Thanks to **Eleanore Klepser** for her patience and persistance in helping me get started as class secretary. We now have the mail being directed to me, and columns should appear more regularly.—**Joe Shaffery**, Secretary, 34 Hastings Drive, Fort Salonga, NY 11768

67 15th Reunion

You should have received, or will receive shortly, a final reminder to join us at our 15th Reunion, June 10-13, 1982. You will certainly enjoy the Friday night dinner dance at the Lyman Estate, with 40 acres of landscaped gardens, Saturday on charming Thompson Island in the Boston Harbor; and, most important, the chance to renew ties with vintage classmates who have improved with 15 years of aging. **John Rudy** reports that the response so far has been good and a large turnout is expected.

Ross Corotis has left Northwestern University, where he was professor of civil engineering, to head the development of civil engineering at Johns Hopkins University. He reports that both Hopkins and Baltimore are exciting places. . . . **Russ Johnston** and his family have moved to Caracas, Venezuela, where Russ is managing director for the consulting operations of the Management Analysis Center of Cambridge. . . . **Richard Cutler** is an instructor of mathematics at Villanova University. . . . **Louis Schwartzkopf** teaches physics and engineering at Eastern Oregon State College. He'd enjoy hearing from fellow M.I.T. grads who are living in the area or passing through. . . . **Don Berliner** has joined Merck, a pharmaceutical company, in West Point, Pa. . . . **Dick Patton** is working on sound propagation through the ocean at Bell Research Labs in Whippany, N.J. He lives in nearby Merdhen with his wife Peggy and two sons, Mark (1) and David (2). . . . **Rick Dower** writes that son Graham arrived in January 1981, balancing the family at one boy and one girl. Rick's X-ray astronomy paper based on his thesis was finally submitted to the *Astrophysical Journal*—after several annual parties to celebrate the event.

Judith and **Nathan Curland** announce the birth of their first child, Rebecca, on December 23, 1980. . . . **Eric Johnson** has taken a two-year leave of absence from M.I.T. to become director of marketing for Zeltron S.P.A., an Italian microelectronics engineering firm. His wife Kathy, daughter Mari, and son Marcus are all enjoying their stay in Milan. . . . **Avram Bar-Cohen (Markowitz)** and his wife Anat announce the birth of their daughter, Talia Dvora, on June 14, 1981. Avram was recently promoted to associate professor of mechanical engineering at Ben Gurion University, Beer Sheva, Israel. . . . **Bob Landley** and family will be returning to the U.S. this summer after a four-and-a-half-year stay on the Pacific island of Kwajalein. After living in "almost heaven," Bob is concerned about returning to "pollution, traffic, crime, and all the rest of the benefits of civilization." The Landleys would love to live on the big island of Hawaii where they own four acres, but technical jobs there are scarce. They will probably end up in Florida. . . . **Roy Gamse** reports that **Mike Telson** is an energy expert with the House Budget Committee staff. . . . After five years of hi-fi retailing with Tech Hi-Fi (and others in Chicago) and four years managing a regional sales office in St. Louis for U.S. Pioneer, **Bruce Twickler** has moved to Pioneer's corporate office in New Jersey as vice-president of high fidelity components. Bruce, his wife, daughter (9) and son (6) live in Ridgewood, N.J., where Bruce is becoming accustomed once again to East Coast ways, including the excitement of driving to work among the courteous and skillful drivers of New Jersey. He hopes to visit friends from M.I.T. who inhabit the area and have lived to tell about it.—**Jim Swanson**, Secretary, 878 Hoffman Terr., Los Altos, CA 94022

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Paul Arriaga has been manager of technology affairs since 1978 at Maraven, Venezuela's largest oil company. His efforts are concentrated in monitoring technology sources and negotiating technology transfer contracts. . . . **Gary Mayer** and spouse, Kathleen, have a son, Nathan, and the family has moved to Boulder, Colo. . . . **Charles Cramer** is working on electronics design at Hayssen Mfg., Sheboygan, Wis. . . . The closing of the *Star* modified **Mary Thornton**'s reporting of Congressional activities to that of national staff reporter for the *Washington Post*. . . . **Paul Burstein** and spouse, Dotty, were expecting their first child at the time of his last note to me, and he was reading an infinite number of appropriate books. Paul is at AS&E and is applying basic space and medical technology to non-destructive testing. . . . **Donald Edwards** and spouse did post-doctoral studies at Stanford, after he received his Ph.D. in biology at Yale. He studied under the eventual head of the FDA and specialized in studying nerve circuits. After that, they moved to the University of California at Davis for continued post-doctoral work. Donald is presently at Georgia State University as an assistant professor of biology.

David Suheina has been appointed chief of the program analysis section of the National Eye Institute, NIH. . . . **Edward Sayer** is a doctoral level psychologist in a prepaid health plan program in southern New Hampshire and is married to Vearle, who is a psychiatric nurse. . . . **Howard Bluestein** is combining art—severe storm photographs exhibition at the University of Oklahoma Museum of Art—with academia—testing severe storm devices as an assistant professor at the university. Watch *That's Incredible* for re-runs for further details. . . . **Russell Glisker** is expecting an M.B.A. from Harvard in 1982. . . . **Stephen Smith** married Judith Baxter in 1980, and is an associate professor at the University of Illinois, Chicago Circle. Stephen specializes in mathematics and has taught at Caltech and Justus Liebig University (West Germany). . . . **Bob Seymour** finished his Ph.D. in physics and is doing solid state research at G.E. He and Polly, who is working on a Ph.D. in political science, have two boys and live in Wellesley. . . . **George Biehl** writes that after getting his Ph.D. in chemistry, he left to teach in Egypt, which was "quite exciting!"

Lawrence Gessman is associated with the cardiac catheterization lab at a heart and lung center in Browns Mills, N.J. . . . After receiving an M.S. in mechanical engineering from Stanford, **Steven Girshick** is now in the Ph.D. program, working at the High Temperature Gas Dynamics Lab. His wife and two daughters live with him on campus. . . . **Walter Griffith** is teaching math and computer science at the Massachusetts State College at Westfield. . . . **Michael Kearns** is writing papers in the small liberal arts college town of Delaware, Ohio, the heartland of America. . . . **Tim Gilmore** finished medical school and played rugby until his internship commenced. He and Susan had their first child. Susan would like to continue as a reporter in Seattle while Tim continues in a residency or consults. . . . I received a letter from the **Tom Hafer** family, consisting of Tom, Ann, William, and infant Virginia. In the same manner as Maggie's and my third son, Troy, the Hafer's infant was in an intensive care nursery. She was treated by one of Ann's classmates. Both infants are in better health now. . . . **Tom Devine** received the 1981 Marcus A. Grossman Young Author Award of the ASM, for his publication involving stainless steel. Tom is at the G.E. research and development center in Schenectady.

As I indicated above, we have our third son and are continuing to work on our house. Maggie, as attorney for Pepsi Co., and assigned to North American Van Lines, is in charge of all non-personal injury litigation in the U.S. My practice specializes in litigation and most recently in oil and gas ventures. We travel regularly, which leads to constant confusion.—**Robert O. Vegeler**, Kennerk, Dumas, Burke, Backs, and Salin, 2120 Ft. Wayne National Bank Bldg., Fort Wayne, IN 46802

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Marc Roddin writes: "Took two trips to Europe to learn about international trade and transportation of bulk commodities. I'm fully recovered from a broken leg injured while backpacking last fall and can run faster than before the accident. I am going to get married in February, that should be a real change." . . . **Ellen Koerber Sheridan** is practicing internal medicine in Dallas, Tex., and expecting her first child in November. . . . **Lawrence Schmutz** received his Ph.D. in 1978 from M.I.T. in electrical engineering and computer science, joined the Cambridge firm of Adaptive Optica Associates, and is presently vice-president of research and is living in Watertown, Mass. . . . **Gus Vlahakes** writes: "After three years of research fellowship in San Francisco, I've come back to Boston to finish training in cardiac surgery. Although the West was a lot of fun, Boston still seems like home." . . . **David J. Leehey** is assistant professor of medicine, Loyala University Stritch School of Medicine, Maywood, Ill., and is staff physician, Hines V.A. Hospital, Hines, Ill. . . . **Everett E. Sinnet** is working as a grant administrator in the Lung Division at the National Institutes of Health in Bethesda, Md. He and his wife Rachel are expecting their first child in March and are new homeowners in Rockville. He sends regards to all of his Burton House and MacGregor friends. . . . **Mark Gilman**, his wife Ellen, and daughter Andrea (age 7) are living in New Jersey, and Mark is an investment analyst, first with Salomon Brothers and now with Lehman Brothers as vice-president responsible for oil/gas industry economic and financial analysis. He and Ellen miss Boston. . . . **Barney C. Black** is married, but no children at present. He is currently proposal czar for Newport News Industrial, subsidiary of Newport News Shipbuilding. He also does consulting. Most recently, Barney developed a training manual and wrote a trade magazine article about a suit used by rescue squads to pull people out of icy water. . . . **Peter F. Strom** writes: "In a moment of insanity, we moved back to the East Coast from Berkeley, Calif., where I was doing a postdoc. While there we met a rare, native Californian: our son, Russell (now 2 1/2). I am now an assistant professor in the Department of Environmental Science, Cook College, Rutgers University, in New Brunswick, N.J." . . . **Vincent Chiapetta** is currently on leave from the Phoenix, Ariz., firm of Martori, Meyer, Hendricks, and Victor as a visiting assistant professor at the Indiana University School of Law in Bloomington.

I apologize for mssing the November/December issue of the *Review*. The notes were mailed but apparently never reached the Alumni office. Lucy and I are expecting our second child in June. I retire from my duties as president of the Chamber of Commerce and church councilman this year. Hope to spend more time hunting, fishing, flying kites, and enjoying my family. Please write. And come to Texas.—**Hal Moorman**, P.O. Box 1808, Brenham, TX 77833

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It is Christmas today and probably April as you read this. It's something to consider what may have happened as you read this that has not yet happened as I write it. Today there is a crisis just starting in Poland under the repression of the Communist regime and the Soviet Union, but as you read the column it may be all over and Lech Walesa may run Poland. Reggie Jackson is still a limbo resident, and the betting is on Dallas in the Super Bowl. Who knows what laughter the day this is read as the 49ers or someone as unlikely are champions and Reg is starting for Seattle!

While all this foofaraw is going on, **Jared Cohon** was promoted to professor of environmental engineering and assistant dean of engineering at Johns Hopkins. We congratulate him for this exceptional promotion. . . . **Sergio Trindade** is director of a Brazilian firm, Promon Engenharia. . . . **Michael Cedars** is engaged to Phyllis Becker and is a plastic surgery resident at UCLA.

My old friend from the DUs, who has completely forgotten me, **John Kavazanjian**, left Digital Equipment Corp. in July after seven terrific years. He now lives in Scottsdale, Ariz., where he is vice-president of operations for Intertel, a Phoenix-based maker of small computerized phone systems. . . . Diane and **Larry Esposito** produced Rhea Marie McKnight Esposito, '03, last August 15. They are living in Boulder, Colo., where Diane is a research hydrologist at the U.S. Geological Survey and Larry is in his fifth year at the Lab for Atmospheric and Space Physics at the University of Colorado, Boulder. Care to guess which one is down-to-earth and which always in midair? (A truce to this fooling.) This fine couple have had some exciting times with Larry an investigator on the Saturn mission, the Pioneer; the Voyager missions to Jupiter and Saturn, and the current Pioneer Venus orbiter.

Kevin Lloyd writes that he is manager of planning and special studies for Pittston Petroleum in Montvale, N.J. . . . **William Karp** just finished a resident position in emergency medicine at Louisville General. Bill would love to find a job at the trauma center of a hospital in the Santa Barbara-Los Angeles area if anyone knows of any openings. . . . **Christos Demetriou** left M.I.T. in 1975 to study in England for a year. He then "returned to his native country" (which he doesn't mention but presumably is Cyprus, according to the old student directory I keep for such emergencies) as director of Ambrosia Oils, engaged in refining vegetable oils and margarine production.

I received a Christmas card from Pat and **Bill Gulley**, who live in Norwich, Conn., where Bill is in OB/GYN and has been blessed with two children, Sean, '00, (3), and Katie,'03, born three days before our own JR last March 27. . . . Kathy and **Tony Scandora** talked to me yesterday as we exchanged Christmas greetings; nothing really new out there. . . . On the home front, the DP department of the distinguished Warrenton accounting firm of Surles and Associates (which I manage) made budget for my first fiscal period. I couldn't be more excited. Brag, brag, brag. Write.
—**Robert M. O. Sutton, Sr.**, Secretary, 819 Buckingham Ct., Warrenton, VA 22186

75

Much has happened since our last class column. . . . *What's the news in the computer world?* **Charles Baker** has been at Wang for over five years; he is writing BASIC application programs. He is still "addicted" to bicycling and estimates he has ridden more than 50,000 miles, mostly in New England, including a number of races. . . . **Marta Greenberg** moved to Nashua, N.H., last year and is a partner in Software Innovations Inc. The firm specializes in language and operating system work, primarily under UNIX. Also on board is Bill Exell '76, who recently married Dr. Marilynn Acker. . . . **Steven Slesinger** is designing large software systems at DBA Systems, Inc., in Melbourne, Fla. He is also "enjoying the beaches and lots of backgammon." . . . **Chee Yap** joined the Computer Science Department at the Courant Institute of Mathematical Sciences (N.Y.U.) last fall as assistant professor. . . . **Michael Picheny** received his Sc.D. in electrical engineering after ten years at M.I.T. "In between theses, exams, etc., I married Barbara Bolshon (S.M., Sloan School, '78)." They now live in Tarrytown, N.Y. where Michael works at the IBM T.J. Watson Research Center on speech recognition by computer, and Barbara works at Merrill Lynch in marketing research. . . . **Karen Ellen (Chen) Irwin** will be finishing a Ph.D. in electrical engineering in June 1982.

In other news: **Sandy (Kelly) Fillebrown** has been married for about two years and is living in the Philadelphia area. "I received my master's in math a year ago, tried industry for a while and didn't like it. I am teaching and doing research at Drexel University and hope to return to school for my doctorate next year." . . .**Arthur Apter** writes: "After spending the last two years at the Universi-

ty of Miami, I have returned to civilization by accepting a position as assistant professor in the math department at Rutgers, Newark. I am looking forward to some nice cold weather!" . . . **James Farnsworth** is the manager of engineering research in the Industrial Ceramics Division of the Norton Co. He manages a pilot plant of 15 people which produces a variety of advanced materials for hostile environment applications. These are non-oxide ceramic materials such as Sic and Si_3N_4. . . . **Sherman Wang**: "Greetings from the land of the sun and sand! After two-and-one-half years, I still find it hard to leave the oasis at the Ministry of Finance, Saudi Arabia. Maybe this spring I will return round-the-world home. Glad to have seen some classmates in odd places in the States and our former class president Anita in Europe." . . . From **Alan Lefkof**: "Ann and I are still enjoying the San Francisco Bay area. Luckily we bought our house in the Oakland hills during 1978, before prices and interest rates spiraled out of control. Ann is a senior associate at Economics Research Associates doing feasibility studies for urban rehabs and resort developments. (It's fun to tag along for the resort market research work—my golf game is improving steadily.) I am an engagement manager at McKinsey and Co., a general management consulting firm. My client base has included transportation, retailing, and electronics companies. While working for the American Association of Railroads, I traveled frequently to Washington, D.C. to testify before Congress and the I.C.C. in the railroad deregulation hearings." . . . **Kay Anderson** is now living in the Big Apple: "I am making an effort to really enjoy the City so that if and when I move away I won't regret what I didn't see." She adds that she is enjoying her job at the New York Stock Exchange as a manager of financial analysis.

Medical news: **Evan Schwartz** has started residency in orthopedic surgery at the Albert Einstein College of Medicine. . . . **David Kerski** is in a psychiatry residency at University Hospitals, Madison, Wis.

Finally I am thrilled and delighted to report two births: Allan and **Sandra Lakin** had a baby boy named Paul Robert on September 18, 1981. Sandra recently received her M.S. in computer science from the University of Southern California and is working on her Ph.D. there. Alan, ('74) is working for Rockwell and going to Loyola Law School, Los Angeles at night. . . . **Diane McKnight** and Larry Esposito ('73) had a baby girl named Rhea Marie McKnight Esposito on August 15, 1981. Diane has returned to her job as a research hydrologist at the U.S. Geological Survey. Larry is at the Laboratory for Atmospheric and Space Physics at the University of Colorado at Boulder. . . . Keep up the good work.—**Alex Castaldo**, Secretary, 929 Massachusetts Ave. 12D, Cambridge, MA 02139

76

We have a fair amount of news from the mails. Please keep it coming. From **Barry Goldman**: "I was recently promoted to senior consultant at Touche Ross and Co., where I have been since graduation from Harvard Business School in 1979. At the end of August, I went on a Club Med vacation and ran into **Jeff Buerman**. My building in New Jersey underwent a co-op conversion, and I am now a homeowner having bought my apartment." . . . **Alfred Sharon** writes: "I am currently in my second year of a master of divinity program at the Lutheran School of Theology in Chicago. Three years working as an engineer was all I could take before going back to school. I received a North American Ministerial Fellowship to study here, and am very much enjoying the program. I find theology to be eminently more meaningful than engineering at this time and am pretty sure of going into some kind of church work when I finish." . . . **Barbara Barres**: "I am currently a second-year neurology resident and am really enjoying it. When I finish here I plan to enter gradaute school and study neurobiology." . . . And **Ed Capparelli**, another M.D.: "I am currently in my last year of a family practice residency program in McAllen, Tex. I just returned from five weeks' work among the Miskito Indians in rural eastern Honduras and hope to do more work among these Indians in the future. Other good news, my wife Gillian (Middlebury '75) and I are expecting our first child in April."

A note from **Mark Deric**: "Though selling industrial central systems in Boomtown Houston is not without its high moments, the distraction caused by the existence of even more lucrative pursuits is getting unbearable. My combined interests in industrial systems and the associated entrepreneurial opportunities in the energy market, project financing and investment banking generally, and international interest rate arbitrage are pulling me toward Stanford for business school."

A brief note from **F. S. Tsuchiya** indicates that he is currently the manager of Mechanical Systems Engineering, Vehicle Dynamics Division, MTS Systems Corp. He is also a member of the M.I.T. Minnesota Educational Council and board of directors, M.I.T. Minnesota Alumni Club. . . . **Larry Stewart** sends word that he received a Ph.D. in electrical engineering from Stanford in June 1981 and is now at the Computer Science Lab, Xerox Park. . . . From Katherine Stohlman: "**Tom Stohlman** and I are living in Hingham, Mass., and working hard." (Secretary's note: At what? More details, please.) . . . From Holly Willsey-Walker, wife of **David Walker**: "Our trip to Switzerland and Germany was great. David's paper was well recieved. As we were fooling around the switchbacks in the Alps, David kept saying, 'I wish I had my BMW here.' I (with the white knuckles) was glad he didn't. Not too many language problems. One night I was tired of translating menus and wanted to just pick at random—good thing I didn't. The thing I chose was octopus—not a favorite."

From Barbara Ann, '77, and **Mark Crane**: "We are doing well here in Colorado. Barbara Ann has taken over class secretary duties from Doug McLeod and we are both active in the Colorado Alumni Club and serve as vice-chairmen for the Colorado Educational Council group helping Gordon Moore. Digital still employs us and keeps us busy. I am still working as a distribution analyst but have recently taken on the development and supervision of an internal inventory audit group for our materials organization. Much to be learned about the cut inventory levels. Inventory control will be a major issue in the future profitability of DEC and other U.S. companies. We are enjoying a part of the landed gentry—excuse me, I mean landed poor. Never would I have believed that the financial markets could blow up like they have (Secratary's note: I do. I trade them!) Still, it is much fun breaking in a new home."

And a letter from **Geoff Garner**: "I have taken a leave of absence from American Electrical Power and returned to M.I.T. as planned for a Ph.D. in mechanical engineering, which I hope to complete in 2-3 years. I plan to do the research in systems dynamics and control. I have a research assistantship at Draper Lab; the R.A. involves work on a safety parameter display system for the Waterford Nuclear Plant. A certain amount of readjustment to being a graduate student was necessary. I'm living in an apartment at the corner of Commonwealth Ave. and Harvard Ave. . . . **Martin Brock**, who is a graduate student in computer science at M.I.T., lives in the next building in an apartment that is a mirror-image of mine. My new address is: 1238 Commonwealth Ave., Apt. 52, Allston, MA 02134, home (617) 735-0378, office (617) 258-1302."

I had the pleasure of having dinner with Linda Roux, '78, who reports that she is making excellent research progress toward her Ph.D. at Sloan-Kettering. She also told me that she will be assisting Cheryl Allen, '78, in finding an apartment. Cheryl will be starting Columbia Business School in January 1982.

Your secretary saw **Erland van Lidth de Jeude** at his loft in TriBeCa. (Spelling is correct. It is an abbreviation for Triangle Below Canal Street.) Erland just finished making a horror film with Martin Landau and Donald Pleasance. And he had upcoming a role in a soap, *The Edge of Night*. He will be playing the bodyguard of a dwarf drug dealer named Mr. Big! He said it should be fun. I think it will be hilarious!

As for your secretary, I have made a transition. I am the senior commodity spread analyst for Merrill Lynch!I thought I was an international futures expert, and I am pleased to report that they concur. New office: Merrill Lynch, Pierce, Fenner and Smith, Inc., 1 Liberty Plaza (165 Broadway), New York 10080, (212) 637-7148. Insofar as markets are concerned, I am having a fun, albeit at times frightening, time trading interest rates, coffee, cocoa, cattle, and pork bellies. Love that action—can't live without it.—**Arthur J. Carp**, Secretary, 15 Jones Street, Apt. 3D, N.Y., NY 10014

77 5th Reunion

I'd like to take this opportunity to publicly thank those classmates who have supported the 5th Reunion Class Gift effort by giving a minimum of $10 more to the Alumni Fund this year than last year. These Class of '77 10s are (as of January 1st):

Gabriel A. Aeppli
Michael Atlas
Mark E. Beckham
Craig A. Burch
Sergio D. Cabrera
Michael C. Cohen
Richard M. Ehrlich
Thomas A. Frank
Ralph E. Grismala
J. Ernest Gross, III
Michael R. Gugenheim
Michael J. Haney
Kenneth J. Launie
Daniel H. Leighton
Alexander Ling, Jr.
Mark A. Long
Robert H. Lustig
Virginia P. Potter
Steven J. Schiff
Steven H. Spiro
Sue E. Stewart
Steven A. Swernofsky
Scott E. Truesdell
Mark C. Van Stolk
Robert S. Vincent

If your're not yet a 10, you have until June 11 to become one! Contact Carol Martin for more information (283 Brown Bear Crossing, Nagog Woods, MA 01718).

Todd Glickman is currently employed as a broadcast meteorologist at Weather Services in Bedford, Mass. He can be heard on 50 stations nationwide, including WEEI in Boston. He is also responsible for the development of new products for the weather data time-sharing service. . . . **Matthew Sherman** married Janet Sharon Cohen on June 21, 1981. The wedding was attended my classmates **Steven Bader** and **Henry Frechter**. Matthew is currently living outside Washington, D.C., and finishing a residency in medicine at Georgetown University Hospital. . . . **Carlos Acevedo** is now living in a small town in southwestern Puerto Rico, working as a project manager for Digital Equipment Corp. He writes that he is glad to be back with his family, and living in true country, rather than in the city. Sounds good, Carlos! . . . **Stephen Blatt** dropped us a short (!) note that he has received his Ph.D. in physics from Yale University.

It is my sad duty to report the death of one of our classmates, **Rena Ganzberg.** Rena died November 12, 1981, of a progressive illness. Rena's twin brother, **Steven Ganzberg,** reported that she had completed two-and-a-half years at Mt. Sinai School of Medicine. Steven has finished dental school at the University of Pennsylvania and is presently traveling, before settling down to practice.

That's all the mail in the box this month—I hope to hear from more of you soon.—**Barbara Crane**, Secretary, 6431 Galway Dr., Colorado Springs, CO 80907

79

Greetings, classmates! Just a few tidbits for your reading pleasure. . . . **Christopher Rose** is still gracing the hallowed halls of M.I.T. He got his master's in electrical engineering last June and is pursuing a doctorate on a Bell Labs Cooperative Research Fellowship. Christopher reports that **Adonis Neblett** is in his last year of law school at the University of Seattle. Says Christopher, "He's tearing the place up and will be a big-time lawyer soon!" . . . **Jesus Alvarez** joined IBM's Industrial

Automation Group in October 1981. . . . **Daniel Miranker** spent two years in Utah "skiing and organizing against the MX missile." (Two of my favorite pasttimes as well!!) Daniel is now back in the Big Apple in a computer science Ph.D. program at Columbia University. "It's a new department," says Daniel, "but everyone there is sure it will rival the big names before long."

Lugi Boza spent two years at the University of Toronto working for a master's in civil engineering (transportation systems). At press time, he plans to return home to Lima, Peru, to probably work for Volvo Corp. Says Luigi, "I would like to say 'hi' to all my friends from the varsity soccer team of 1976-1979 and invite them to visit me whenever they wish." . . . **Daniel Jones** writes, "Janet McCleary, '78) and I are currently at Ft. Devans at the Army's intelligence School (yes, we've already heard that joke). Did you know that Ft. Devans was the only place that Paul Gray has ever worked outside of M.I.T. (or so legend has it)? We will eventually end up at Ft. Hood, Tex, where I will be assigned to the 1st Calvalry Division ('Apocalypse Now' fans may be acquainted with said unit). Janet's assignment there is still unknown." Both Dan and Janet are alumni of the Technology Policy Program.

Jeffrey Bloch worked for a year and a half at American Sicence and Engineering in Cambridge, developing image processing software for NASA's International Solar Polar Mission Spacecraft. In January 1981, he entered the graduate physics department at the University of Wisconsin, Madison, Jeffrey had a research assistant ship with the space physics group last summer, and he hopes to do his thesis there. . . . **William Cimino** is in his second year at the Yale School of Medicine, along with nine other M.T.T. graduates. He also got his master's in Course III at the 'Tute in 1980.

Eran Broshy finished M.I.T. a semester early, then went on to Stanford for a master's in civil engineering. He is now with Swinerton & Walberg, a San Francisco-based general contractor. He is currently the assistant project manager on citibank's new San Francisco headquarters—a 40-story building. "a pretty exciting business all around," he says. (Hi, Eran!) . . . **Donald Williams, Jr.,** has been working with the architectural firm of Goshow Assoc. since graduation. "New York is A-OK and one encounters a good many 'Tute alumni here. Greetings to all tame ducks! . . . **Bogdan Dawidowicz** has been with General Motors since graduation, but has recently had a change of locale. He will be spending the next two and a half years as a manufacturing engineer in Cadiz, Spain, where Delco Products is building a shock absorber plant. . . . **Brad Miller** is a system's engineer for Access Corp., designing new database systems.

Everybody seems to be married these days! **Katharine Malcolm Stohlman** and hubby Tom Stohlman, '76 are "living in Hingham, Mass., and working hard." . . . **Douglas Pastorello** is married to the former Donna Larsen and is the proud father of 3-month-old Jason. They've just bought a house in the Long Island town of Coram, N.Y. Douglas is gainfully employed by Standard Microsystems Corp., where he works in the CAD group on computer tools for VLSI design. . . . **Carl Baranowski** and **Tim Ramsey** were both present at the wedding of Frank Chung, '78, and Sanhee Choi in Los Angeles last September 12. . . . **David Miller** graduated from Stanford last June with an M.S. in structural engineering. He's now doing earthquake damage prediction research at URS/John Blume in San Francisco. Dave and wife Naomi Miller, '78, just bought a house in Oakland, a half-mile from the Hayward Fault! (I *knew* there was a reason why I don't live in California!)

Our class agent, **Brenda Hambleton**, is an admissions officer in M.I.T.'s Office of Admissions. (Who says you can't go home again?!) . . . Apologies to **Bogy Cimoszko**, who must have experienced a severe identity crisis after reading my November 1981 column. A typographical error turned Bogy from "she" to a "he"! Well, it's cheaper than a sex change operation anyway!

See you all next month. Just think—you can have your very own name in this space. I'm only 13 cents away.—**Sharon Lowenheim**, Secretary, 131 E. 83 St., Apt. 2G, New York, NY 10028

80

Lots of news this month, folks. . . . **John Molitoris** writes that he is tired of reading about classmates that he does not know, so he gave me the following lowdown on some that he does know. **"Larry Lembo** can be seen meandering about the physics department of Stanford University where he is a second-year graduate student. Larry is working with Nobel laureate Arthur Schawlow's research group and is really getting into it. At a recent department picnic, Larry put his 'all' into a football game and managed a 'head on' collision with another graduate student. Both were knocked cold, but are now doing fine. (This was inelastic scattering). . . . **Tom Coan** just finished a summer working in the nuclear science division of Lawrence Berkeley Laboratory. He moved into a new apartment in Berkeley and is setting his goals for a Ph.D. in solid state physics at the University of California at Berkeley. . . . **Mike Blasquez** is spending time at Columbia University studying physics and math, working towards a Ph.D. He intends to visit sunny California for Thanksgiving for some well earned rest and relaxation. . . . **Bill Cimino** is progressing in medical school at Yale. He claims that 'cadavers may be dull, but they're the best friend a medical student has.' I don't know if that's true, but eight-hour class days, five days a week, plus preparation, really limit one's life style. Bill still takes time off to relax and tear up New Haven with Mike Reis, '79. . . . As for me, **John Molitoris**, I spent some time in Germany working on my thesis, and I am now enjoying my second year at the Stanford physics department. My wife, Justine, and I have just celebrated our first anniversary together, and married life has really been great! I am hoping to see some of my fraternity brothers from LCA over the holidays, since quite a few of us are in the San Francisco Bay area. (Hear that, **Bob Edelberg** and **Mike Van Riper**?)" Thanks for the assist this month, John!

Sai Leong wrote recently to ask if there is life still back at M.I.T. (Still? What do you mean, Sai?) Sai is now putting in his second year in the windy Chicago area, working as a process engineer at Quaker Oats and making "all types of cereals." I guess if I wind up with sugar-coated sliderules one morning, I'll know where they came from! Sai says that he is adjusting to the slower pace of the Midwest, but he misses Boston. . . . **Bill Weike** was also in Chicago this summer, working for the law firm of Kirkland and Ellis. During the rest of the year, Bill is a law student at the University of Michigan. . . . **Harvey Alcabes**, having finished up his "double-or-nothing" S.B. and S.M. degrees at M.I.T. in June, spent the summer traveling around Europe with just a Eurail pass and a backpack. He is now living in Mountain View, Calif., doing software work for office automation systems for ROLM Corp. in Santa Clara. Harvey has run into a lot of M.I.T. alumni in the San Fransicso Bay area, including **Abe Ledderman** (Hewlett Packard in Cupertino) and **John Maloney** (Xerox in Palo Alto). Harvey asked me to pass on an invitation to anyone who knows him to visit when in Californa.

"Please check your oil." Advice from your local mechanic? No. How about advice from your car? If your car has talked to you lately, it could be that you have a little black box called "Copilot" in it. Developed by **Dean Phillips** and his brother John, Copilot is a microprocessor-based speech synthesizer that plugs into a car to monitor its mechanical functions. A friendly female voice comes out of the radio speakers to warn the driver of a problem. While promoting the product, Dean and his brother have been on talk show programs on TV, at computer shows, and in trade newspapers.

I received a long note from **Russell Blount** filling me in on the exploits of his friends, fellow crewmates, and himself. Russ left December 1 for two months in Saudi Arabia. He was to be based in Dharhran, going out into the field to work on an implementation study for a new industrial town for his company (Day and Zimmerman). His Thanksgiving plans called for him to spend some time in Boston, celebrating the holiday with Pete Holland. Some of Russell's recent crew exploits include his winning the Head of the Charles with the Vesper Boat Club Championship Four (for the second year in a row), and a victory in the Middle States regatta. In the latter race, he defeated former teammate **Ed Gilbert**, who rowed for the New York Athletic Club "until a back injury forced him to retire to a New Jersey medical school." . . . Another recent crew competitor is **George Florentine**. George has been working for Stone and Webster. . . . **Robert Humphries** is attending George Washington University Law School nights. . . . **Granta Nakayama** is working for the Navy in nuclear engineering. . . . **John Jordan** is working for Boeing. He is designing a "solar-powered satellite that automatically cooks spaghetti so that there is a little white dot in the middle." . . . Rumor has it that **Todd Sauke** has picked up a master's degree in physics at Illinois while on the way to his Ph.D. . . . **Alan Weger** is still in Cambridge, and says that it still isn't Rochester. (Sounds pretty perceptive to me.) . . . When last seen, **John Stenard** was still suffering from shoulder problems stemming from the separation he suffered as an M.I.T. wrestler. Word has it that he exercises it by pulling up the anchor when his destroyer leaves port. He may soon move up from ensign to boatswain. . . . A hearty thanks to **Russell Blount** for the above news.

Robert Tait is working in consumer product development for CGW. He writes that he has recently run in two 10,000-meter races, both with times of under 38 minutes. . . . **Robert Glantz** is working on advanced emission control systems for the Rochester Products Division of General Motors. He is also attending the Rochester Institute of Technology parttime with his eye on a master's degree in electrical engineering in 1982.

As for me—well, it's been a pretty active year—finishing school, starting a new job, moving to a new location, and buying a car. If I can keep up that kind of pace this year, I won't have to worry about getting bored! This column also keeps me hopping, as long as people keep writing. The address, you ask? Why, certainly.—**Ken Turkewitz**, Secretary, 3 Winslow Rd., Belmont, MA 02178, (617) 489-2441

81

To quote a famous sage: "Iffen ya don't write, it don't git printed." I mean I could just start making stuff up, but I doubt those mentioned would appreciate it. Also, there's an enormous time delay (as much as six months) between my receipt of your letters and their getting printed in the column. With those caveats in mind, let's see what finally turned up in the mailbox this month.

In the "Gosh-I-just-can't-get-enough-of-the-'Tute!" department, **Lynn Radlauer** reports that **Therese Prisby** is at Sloan School getting her master's degree. Meanwhile, **Jeffrey Solof** has been appointed the new telethon coordinator for the Alumni Fund. Good luck, Jeff.

In the "I've-left-the-'Tute-and-I'm-just-fine" department, **George Lesieutre** writes that after graduation, he bicycled with **Dave Slobodin** and **Gary Braun** (Gustavus Adolphus) through the Adirondacks to Minnesota, married his high school sweetheart last August 1 and is now busy designing large space structures for Rockwell International's Space Operations and Satellite Systems Division in Seal Beach, Calif. (Not bad for a year's work, huh?)

In the "Look-what-I-brought-home-for-dinner" department, **Julie Neuringer** is busy in her first year of medical school, learning the basics and performing in-depth studies of cadavers.

Finally, in the "Oh-I-just-had-to-call-and-tell-the-class-secretary!" department, **Rob Firester** called to say that **Sandra Zack** is engaged to Stuart Litwin, '80, and living in Arizona. The marriage is tentatively set for May. Congratulations!

That's all folks. Keep those cards and letters coming.—**Chuck Markham**, Secretary, 532 Beacon St., Boston, MA 02215

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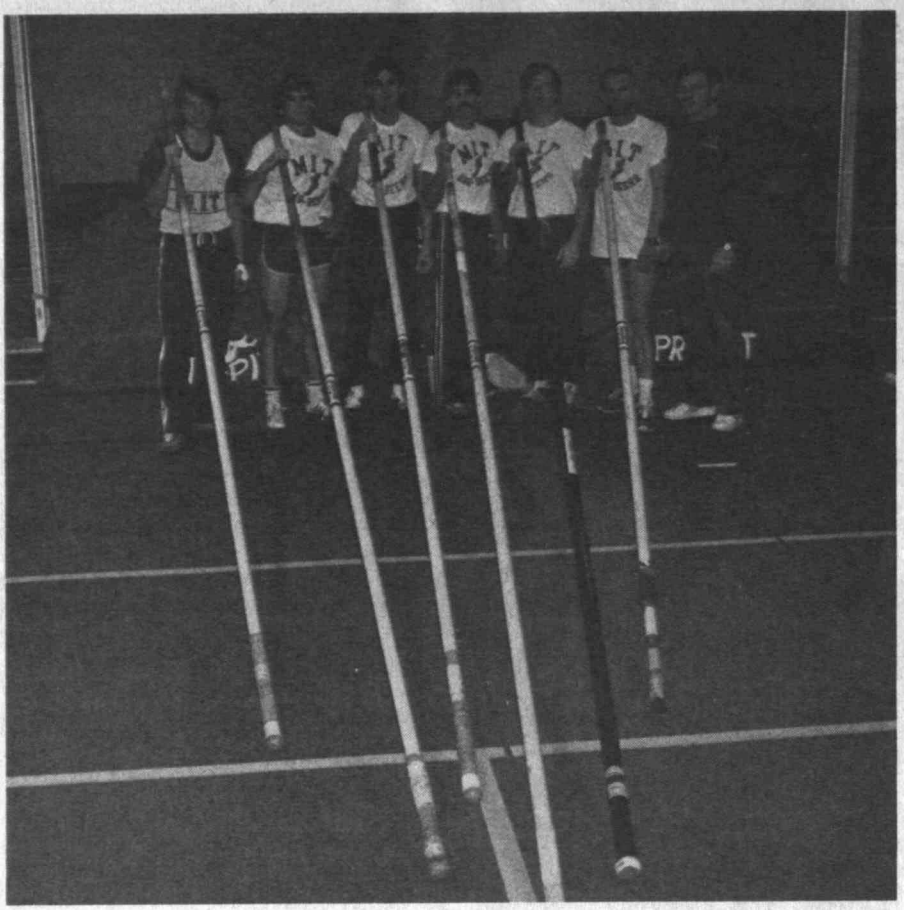
the Coop



The score was lop-sided—73-40—when the 1981-82 varsity was challenged by the alumni in the eighth annual varsity-alumni indoor track meet early this year. But there were winners on both sides—including David R. Wilson, '73, (third from the right, above) in the pole vault. Wilson's competition (he was New England champion as an undergraduate) included (left to right) Mark Dudley, '83, Ed Ingenito, '79, Jon Goldstick, '80, Lew Bender, '81, and Curt Burrowes, Jr., '56. With them at the right is track coach Gordon Kelly, whose advice to his team was clearly followed by all participants: "Track is too much work to go half-way. Go all the way and have no regrets," he writes in a handbook for the track team. "The key to success is improvement; strive for it at every opportunity. The people who put the most into it usually get the most out of it." (Photo: Ken Cerino)

Sports for More Than Ever

Final figures from Royce N. Flippin, Jr., athletic director: in 1980-81 there were 1,289 intramural teams at M.I.T. with 12,067 student participants and 32 varsity teams (21 for men, 11 for women) with 850 participants in more than 500 events—a busy year indeed for the Athletic Department. In all, 19 percent of the M.I.T. student body competed in intercollegiate athletics—26 percent of the women, 17 percent of the men. It's one of the largest intercollegiate athletic programs in the country, says Kenneth J. Cerino, sports information director.

A New Home for Zeta Psi, But the IRDF Needs Help

Zeta Psi fraternity is now in the second and third floors of 233 Massachusetts Avenue, Cambridge, between M.I.T. and Central Square. The first and fourth floors of the building are occupied by commercial tenants, and that's not quite ideal. But renovating is cheaper than building, and Stephen D. Immerman, business adviser to fraternities and independent living groups, told Max Hailperin, '85, of *The Tech* that "it took us three years to find this site."

The renovation was made possible by a $700,000 loan from the Independent Residence Development Fund, a fund contributed by alumni for use exclusively for long-term, low-interest loans to independent living groups.

Mr. Immerman says the loan to Zeta Psi is one of the largest in IRDF history, and it has left the fund's reserves "uncomfortably low. . . . If a house burned down right now, we'd not be able to rebuild," he told Mr. Hailperin.

Meetings and Conferences

The following are among major meetings now scheduled at M.I.T. and by M.I.T. related groups during the balance of this year (for information: Joseph J. Martori, associate secretary of the Alumni Association, Room 10-115M). In addition, a group of 50 short courses on timely topics in technology will be offered at the Institute during the 1982 Summer Session, and five programs in transportation technology and planning will be offered in July and August by the M.I.T. Center for Transporation Studies (for information: Office of the Summer Session, Room E19-356; and Center for Transportation Studies, Room 1-123).

March 24-26, 1982 (Cambridge)
Second Conference on Computer Graphics in CAD/CAM Systems
March 30 (Cambridge)
Seminar on fusion research at M.I.T.*
April 3, 1982 (Cambridge) Conference on career change and professional growth (sponsored by the Association of M.I.T. Alumnae and the Boston Chapter of the Society of Women Engineers)
April 6 (Cambridge)
Symposium on synthetic fuels*
April 14 1982 (Cambridge)
Symposium on future corporate strategies*
April 14-16 (Cambridge) Symposium on advances in nuclear systems thermal analysis
April 28 (Cambridge)
Symposium on advances in tribology*
May 4 (Cambridge)
Symposium on lasers in spectroscopy and technology*
May 20 (Cambridge)
Symposium on electronic materials and devices*
May 26 (Cambridge)
Symposium on corporate office automation*
June, July, and August (Cambridge)
Short courses in advanced microcomputer concepts and applications
June 10-13 (Cambridge)
"Tech Night at the Pops" (June 10), Technology Day (June 11) and alumni reunions
June 14-17, 1982 (Cambridge)
Power Electronics Specialist Conference
June 17-20, 1982 (Cambridge)
Annual conference of the American Humanist Association
June 21-22 (Cambridge)
Conference on facilities management for senior executives
June 21-25, 1982 (Cambridge)
Conference on advances in finite element methods in structural mechanics
June 24-27, 1982 (Cambridge)
First National Conference on Black Administrators at White Campuses
(sponsored by the Association of Black Administrators at M.I.T.)
August 2-5, 1982 (Cambridge)
Third International Conference on the Behavior of Off-shore Structures
August 18-22 (Cambridge)
Research conference of the International Federation of Organic Agriculture Movements
September 24-25, 1982 (San Francisco)
M.I.T. Alumni Officers Conference (West)
October 2-3, 1982 (Cambridge)
Centennial celebration of the Department of Electrical Engineering and Computer Science
October 5-7 (Amman, Jordan)
Conference on regionalism and international air transportation
October 8-9, 1982 (Philadelphia)
M.I.T. Alumni Officers Conference (East)
October 14-15 (Cambridge)
Second national remanufacturing conference

*Attendance limited to representatives of companies in the M.I.T. Industrial Liaison Program.

The dome that isn't there. The collapse of the "bubble" covering the J.B. Carr Tennis Courts in the early morning hours left this dismal scene on January 14. A light snow was falling, the weather was calm, and Paul Barrett, director of physical plant, told Anthony Zamparutti, '84, of The Tech *that "it's not immediately clear what happened." A malfunction in the inflation system seemed likely, he said. The fabric was damaged, and repairs will be possible only in the spring, according to Kenneth J. Cerino, director of sports information. (Photo: William Coderre from* The Tech*)*

Early Applications Up; 288 Already in '86

The largest pool of early applicants in M.I.T.'s history netted a total of 288 admissions to the Class of 1986 at the end of last year, and as this issue of the *Review* went to press the Admissions Office was reviewing a near-avalanche of applications for decision on the regular spring schedule.

"In this period of recession and layoffs," Peter H. Richardson, '48, director of admissions, told *The Tech*, "what people want is security. It looks as if the money is in the field of technology." There's also been stepped-up recruiting for M.I.T. this year, with the Admissions Office staff logging more hours on the road than ever before.

There were 21 percent more applicants for early action in 1981 than in the previous year—a total of 871. Of those, 158 came from women—a 23 percent increase over 1980. One-third of the applicants were accepted, with the remainder held over for consideration in March.

M.I.T.'s increase in early-decision applicants was believed the largest among Ivy League universities with early-action programs.

100 Years of Fraternities

The centennial of fraternities at M.I.T.—the 100th birthday of Sigma Chi—will be the object of a campus-wide celebration on April 16 and 17 at which fraternity alumni will be special guests.

Plans of the Interfraternity Conference now in place include a ball at the Sheraton-Boston Hotel on Friday evening, a day-long symposium on fraternity contributions to Institute life on Saturday, and a special exhibition on the history and role of fraternities at the Institute arranged by the M.I.T. Museum.

For further information: Eric Gold, '83, Phi Kappa Sigma, 530 Beacon Street, Boston 02115; or Stephen D. Immerman, business adviser to fraternities, Room 7-133, M.I.T.

John M. Deutch Is Dean of Science

John M. Deutch, '61, Arthur C. Cope Professor of Chemistry who was for three years director of the Office of Energy Research and under secretary of the Department of Energy, is now dean of the School of Science. He succeeds Robert A. Alberty, who stepped aside on March 1 after 15 years in that post.

Dr. Deutsch graduated simultaneously from Amherst College (history and economics) and M.I.T. (chemical engineering) under a joint study program. He went immediately to Washington to join the Systems Analysis Group in the office of the secretary of defense. Later he returned to M.I.T. for graduate study in chemistry (Ph.D. 1965), and after five years at the National Bureau of Standards and Princeton University he returned once more to join the faculty as associate professor of chemistry in 1970.

Since then, Dr. Deutch has continued to hold a number of responsibilities in Washington. He is now a member of the Defense Science Board and from 1970 to 1974 was a member of National Science Foundation's Advisory Panel for Chemistry, of which he was chairman in 1972-73. This "extensive experience in Washington will be a valuable asset" to him as dean, Dr. Alberty said in the announcement of the selection of his successor. After a short transition period, Dr. Alberty will return to teaching and research as a member of the chemistry faculty.

$30,000 for the Student Center

Revenues from the 24-hour coffeehouse in the Student Center are now accumulating into an endowment fund, the income from which will buy new furnishings and equipment for the building. And the fund now stands at $30,000, Steven F. Thomas, '81, chairman of the Student Center Committee, told Dean Shirley McBay at a dean's office staff meeting late last year.

McDermott Award to Moore

Henry Moore, eminent American sculptor whose "Three-Piece Reclining Figure, Draped" is now a feature of the Killian Court, received the McDermott Award of the Council for the Arts at M.I.T. late last fall. The citation, referring to the sculpture in the Killian Court, said in part, "We record here a lasting gratitude on behalf of generations of students who in this place and in their time will find in (the sculptor's) manifold secrets the embodied energy of creative thought."

41 Asked to Withdraw

On the basis of their academic performance during the fall term of 1981, 41 undergraduates were asked to withdraw from M.I.T. by the Committee on Academic Performance early this year, and 187 undergraduates received warnings.

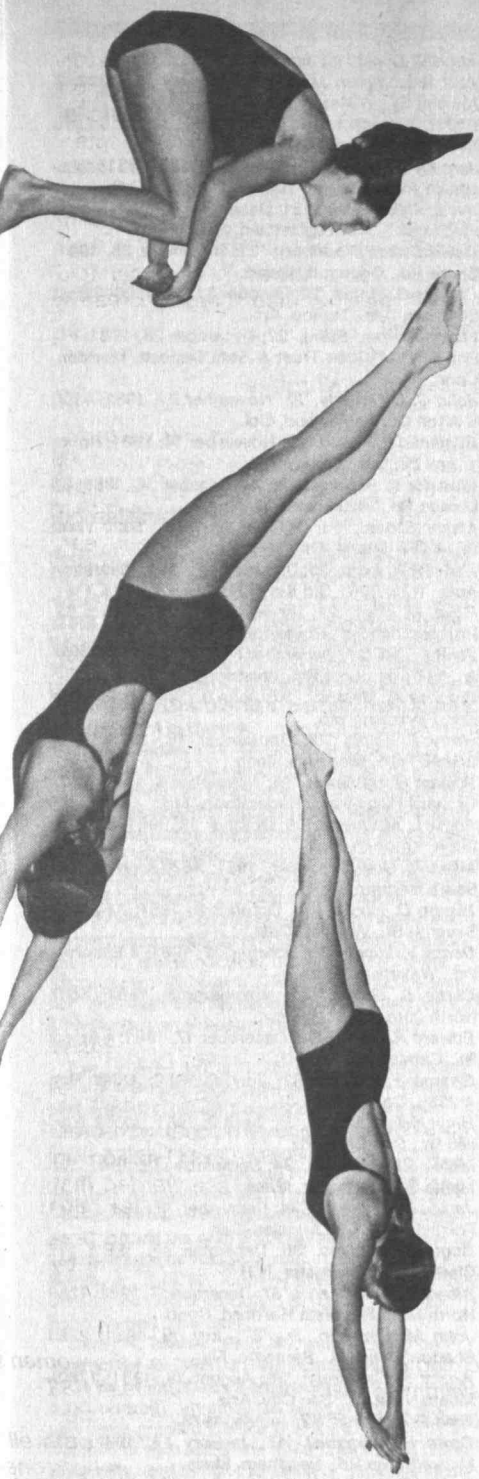
The numbers are not unusual—less than 1 percent of the undergraduates (including *no* freshmen) asked to withdraw and 4 percent placed on warning, Professor Judson R. Baron, Sc.D, Chairman of the CAP, told Ivan Fong, '83, of *The Tech.*

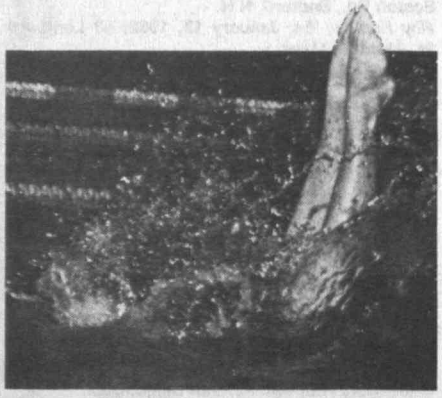
A student required to withdraw must leave M.I.T. for at least one term and then may apply for readmission; no student not already on warning is asked to withdraw. Neither CAP action appears on a student's permanent transcript.

Research Volume: Up $9 Million

Sponsored research at M.I.T. in 1981-82 will be about $193 million, according to mid-winter estimates by Robert M. Dankese, associate budget director. That compares with $184 million in 1980-81. But Mr. Dankese warned that uncertainties were still very great, and he delayed until spring the detailed predictions which are usually available by late fall.

Going it alone. Of two divers on the women's swimming team, only Ann Tulintseff, '83 (below) was ready to face Salem State College on January 22. But it came out well enough: Ms. Tulintseff took first in both one- and three-meter (right) events, and M.I.T. won 87-49. (Photos: Gerard Weatherby, '82, from The Tech*)*





Communications for Alumni

The communications revolution that now surrounds us—and will continue to change our lives for the next decade or more, according to most experts—will be the topic of major addresses during Technology Day on Friday, June 11.

The experts' discussion of future communications technology and its implications will be preceded by "Tech Night at the Pops" on June 10 and followed on June 11 by the traditional alumni luncheon and afternoon displays and demonstrations of future communications systems.

For further information: Joseph J. Martori, Room 10-115M, M.I.T.

2.5 Million for Cognitive Science

A $2.5 million grant for research in cognitive science has come to M.I.T. from the Alfred P. Sloan Foundation, part of a $10 million commitment to this field announced by the foundation last fall. Other recipients included the University of California, Berkeley ($2.5 million), Carnegie-Mellon University ($1 million), and Stanford University ($1 million). An earlier $10 million for research in cognitive science means that this program has been the largest in the Sloan Foundation's history.

Visits with the President

At least one-third of the visitors who took advantage of President Paul E. Gray's open office hours during the second half of last year came because "they just wanted to get acquainted," Dr. Gray told Barry S. Surman, '84, of *The Tech*—who himself took advantage of just such an opportunity to ask the question.

President Gray liked that, he said, and he's continuing the open hours this spring. "There's been no issue or concern or question that really bowled me over," he told Mr. Surman. "It's a very low-barrier opportunity for access to the president. . . . The perspectives I've gained have been valuable."

H. Burr Steinbach, 1905-1981

H. Burr Steinbach, who served as first dean of the combined doctoral program of M.I.T. and the Woods Hole Oceanographic Institution from 1963 to 1972, died in Falmouth, Mass., on December 21, 1981.

In addition to his activities at the Woods Hole Oceanographic Institution, Dr. Steinbach was for many years director of the Marine Biology Laboratory at Woods Hole.

Roy Kaplow, 1933-1982

Roy Kaplow, '54, professor of materials science and education, died at his home in Newton, Mass., on January 13, the victim of an apparent heart attack. At the age of 49, he was active in three fields at M.I.T.—x-ray physics and the structure of noncrystalline materials, photovoltaic and other solar energy systems, and on-line, interactive uses of computers.

Professor Kaplow came to M.I.T. as an undergraduate in 1950 and joined the research staff upon completing his doctorate in metallurgy and material science eight years later.

Professor Kaplow held some 15 patents in the field of x-ray diffraction and was coauthor of a widely-used text in that field. He also headed a three-year project to design and put into operation an experimental computer-based information and learning service for public use in the Cambridge Public Library. He was associate chairman of the faculty and of the faculty's Committee on Educational Policy for several years, and he had been chairman of the M.I.T. Policy Board on Cable Video.

Azel W. Mack, 1895-1982

Azel W. Mack, '15, who had been active in alumni affairs for more than 50 years, died in Wellesley, Mass., January 13.

A graduate in chemical engineering, Mr. Mack had worked in Salt Lake City and later as vice-president of Dexter Chemical Corp., New York, before returning to Cambridge. He had been secretary of his class since 1926, and in that 55-year period had contributed at least 500 reports of classmates' activities to *Technology Review*. He was a member of the executive committee of the Association of Class Secretaries as early as 1940. Meanwhile, he was also active in reunion and fund-raising activities of his class and was a life member of the Alumni Council. For these and other services he was awarded the Bronze Beaver in 1969.

Deceased

Leon J.D. Healy, '09; June 2, 1981; 6930 Crocust Ct. #1, Greendale, Wis.
Lewis S. Southwick, '10; December 18, 1981; Shelter Island Hts., Long Island, N.Y.
Howard S. Currier, '12; December 2, 1981; 1200 Mira Mar Ave., Apt. 808, Medford, Ore.
Fritz Charles Blomquist, '15; October 25, 1981; ECC Retirement Village, Myerstown, Penn.
Alton A. Cook, '15; January 22, 1981.
Azel Washington Mack, '15; January 13, 1982; 7 Atwood St., Wellesley, Mass.
Phil R. Thompson, '19; December 2, 1981; 10 Lake Rd., West Yarmouth, Mass.
Jerome J. Collins, '21; August 28, 1981; 3315 Wisconsin Ave. NW, Apt. 703, Washington, D.C.
Irving Kellogg Peck, '21; December 4, 1981; Meadow Lakes 7-08V, Hightstown, N.J.
David Oakes Woodbury, '21; December 26, 1981; Shore Rd., Ogunquit, Maine.
Charles G. Moore, '22; October 31, 1981; 2645 East Southern Ave., Tempe, Ariz.
Florence Ward Stiles, '22; December 28, 1981; PO Box 951, Meriden Trust & Safe Deposit, Meriden, Conn.
John C. O'Flaherty, '23; November 21, 1981; 4360 S Alton Ct., Englewood, Col.
Benjamin F. Powell, '23; November 10, 1981; Route 1, Box 56, Los Lunas, N.M.
Webster B. Brockelman, '24; October 26, 1981; 38 Lorena Rd., Winchester, Mass.
Meyer Shacat, '25; October 28, 1981; 8020 West Dr. #259, Miami, Fla.
Kenneth S. Lord, '26; December 1, 1981; Plantation Apts. #76, 7061 Old Kings Rd., Jacksonville, Fla.
Royal M. Frye, '27; November 20, 1981; Box 65, Prospect Hill Rd., Royalston, Mass.
John E. Gill, '27; December 5, 1980; c/o R.W. Ray, Jr., 118 Long Lots Rd., Westport, Conn.
Frances A. Meskser, '27; June 9, 1981; 6 Portage Rd., Florissant, Mo.
Harry F. Cade, '28; September 18, 1978; 3314 Scenic Terr., Memphis, Tenn.
William R. DuVernet, '28; November 6, 1981; 1302 Orchard Hills Pkwy., Hagerstown, Md.
Frank L. McGuane, '29; October 18, 1981; 4 Valley Edge, Katonah, N.Y.
Miles R. Gray, '29; July, 1981; 1520 Lingate Ln., Santa Barbara, Calif.
Mason D. Hanes, '30; October 9, 1981; 14417 E. Seventh St., Whittier, Calif.
Daniel V. Lucey, '30; October 12, 1981; 9 Elmcrest Rd., Wakefield, Mass.
Curtis B. Brown, '31; November 5, 1981; 1407 North 25th St., Boise, Id.
Edward R. Levine, '32; December 17, 1981; 4 Arrow St., Cambridge, Mass.
George F. Meyer, '32; July 4, 1980; Quail Run #2231, Columbia, S.C.
Hugh Kelsea Moore, '32; April 9, 1981; 10002 Waikiki Dr., Sun City, Ariz.
Milton G. McDonald, '34; September 28, 1981; 154 Maple St., Lexington, Mass.
James B. Kendrick, '34; December 12, 1981; 2871 Forrester Dr., Los Angeles, Calif.
Roger E. LeBlanc, '36; December 17, 1981; 117 Clarke St., Manchester, N.H.
Albrecht E. Reinhardt, '37; December 7, 1981; 1269 North Main St., West Hartford, Conn.
John M. Simpson, Jr., '37; July 19, 1981; 2350 Shadow Oaks Rd., Sarasota, Fla.
Arthur S. Grossman, '39; August 18, 1981; 17806 Monte Vista Ct., Sun City, Ariz.
Fred B. Klercker, '42; June 4, 1973.
David R. Campbell, '47; January 16, 1982; 207 Marked Tree Rd., Needham, Mass.
Arnold F. Brodie, '49; January 24, 1981; 1141 Romney Dr., Pasadena, Calif.
William M. Murphy, Jr., '51; July 10, 1981; 118 New Boston Rd., Bedford, N.H.
Roy Kaplow, '54; January 13, 1982; 68 Lombard St., Newton, Mass.
Gerhard D. Bleicken, '58; December 4, 1981; 18 Wood Rd., Sherborn, Mass.
Alfred R. Tibor, '58; October 12, 1981; 25 Rue Singer, Paris 75016, France
Robert F. Merkle, '59; December 14, 1981; 6 Brent Rd., Lexington, Mass.
Edgar F. Davis, '63; November 13, 1981; 2521 Regent St. #8, Berkeley, Calif.
Alan H. Cooper, '66; October 6, 1981; 25 Kingsweston Rd., Hensbury Bristol, England.
Perry F. Sollars; '67; August 2, 1979; 2929 Buffalo Speedway #2004, Houston, Tex.
Gregory A. Rupprecht, '79; August 30, 1980; Colfax Manor #14B, W. Colfax Ave., Roselle, N.J.
Jerome D. Kalmes, '80; October 25, 1981; 7575 Linda Vista Rd., Apt. 78, San Diego, Calif.

Courses

I
Civil Engineering

Peter W. Likins, S.M.'58, who has been university provost with primary responsibility for the professional schools at Columbia University (since July 1980), will become president of Lehigh University, Bethlehem, Penn., in July 1982. An international authority on the dynamics and control of spacecraft, he has served as consultant to major aerospace firms in the U.S. and to government agencies here and in Europe.

Garrett Sloan, S.M.'40, writes that he is still very active in the former Course XI field of sanitary engineering. As director of the Miami-Dade Water and Sewer Authority, his work includes a large scale construction program to keep pace with rapid growth in this area of Florida. In addition, he has applied many innovative ideas to the solution of local problems. . . . **Richard A. Conway,** S.M.'57, reports that he is now a corporate development fellow with Union Carbide Corp., Charleston, W.V., and is editor of two additional books: *Hazardous Solid Waste Teaching* (ASTM, December 1981) and *Environmental Risk Analysis for Chemicals* (Van Nostrand Reinhold, January 1982).

Eva Lerner-Lam, S.M.'78, writes that she is associate transportation planner at the San Diego Metropolitan Transit Development Board, involved in planning and development of the San Diego trolley, bus transit centers, and regional transit network. . . . **George P. Turci,** S.M.'56, has resigned as president and a member of the executive committee of American Bakeries Co., Chicago, Ill. He will become a special assistant to the board, where he retains a seat. . . . **Brice R. Smith, Jr.,** S.M.'52, formerly executive vice-president of the Sverdrup Corp., St. Louis, Mo., has been elected president.

Gerrit H. Toebes, Ph.D.'59, passed away on September 29, 1981, in West Lafayette, Ind. In 1959 he joined the civil engineering faculty of Purdue University, attaining full professorship, and was twice granted a leave of absence for study in the field of hydraulics—in 1966 at Colorado State University, and in 1974 to teach at the Delft Technological University.

II
Mechanical Engineering

Associate professor **Klaus-Jurgen Bathe,** in the mechanical engineering department at M.I.T., was one of five engineers to receive the Walter L. Huber Civil Engineering Research Prize awarded by the American Society of Civil Engineers to recognize "exceptional research by young engineers." He was cited for his studies in nonlinear computational mechanics. . . . **Bharat Bhushan,** S.M.'71, a research scientist for SKF Industries, Inc., King of Prussia, Penn., was awarded the 1981 Alfred Noble Prize of the American Society of Civil Engineers and other engineering groups, in recognition of two papers dealing with the success of gas bearings, rolling element bearings, and other sliding/rolling components that depend on the availability of suitable coatings. . . . **Carl C. Hiller,** Ph.D.'76, reports that he is employed by Acurex Corp., Mountain View, Calif., responsible for design and engineering of large scale industrial process heat systems using high-temperature solar energy.

Frederick A. Malcolm, S.M.'79, is currently a member of the technical staff at Bell Labs (Merrimack Valley location), North Andover, Mass. . . . **Lawrence S. Daniels,** S.M.'66, formerly vice-president—planning operations at Norton Simon, Inc., has been named vice-president of corporate planning for Uniroyal, Inc., New York, N.Y. He's responsible for the direction of strategic planning, operating, and resource activities of the corporation, including corporate market research, economic analysis, and capital planning.

III
Materials Science and Engineering

Professor **Ronald M. Latanision,** director of the Corrosion Laboratory in the department at M.I.T., has completed a videotaped course of 20 lectures on corrosion engineering which is now available through the Center for Advanced Engineering Study. The series includes a general survey of metallic corrosion, principles for understanding their management, and specific approaches to various corrosion problems. A study guide is also available.

Paul R. Townsend, Met.E.'76, is currently director of research and development in the orthopaedic division of Johnson & Johnson. . . . **Ramon S. Sevilla,** S.M.'39, reports from the Philippines of a family reunion a year ago when all six children were at home in Pasay City, Manilla. The eldest, John is associated with a major management and accounting firm in Jakarta. Linda has just completed all the requirements and is now a full-fledged doctor of medicine; earlier she studied enology at the University of California, and she is the only wine specialist in this field in the area. Another son, Luis, has just finished his M.S. in communication and is connected with the governor's office of a province south of Manila. Carina is finishing her M.B.A. and is now working as chief recruitment officer of one of the commercial banks. Gary is now in his second year of medical school and will graduate in three years.

VI
Electrical Engineering and Computer Science

"Life-long cooperative engineering education" is the subject chosen for a special study by the faculty for presentation next October 2 during the celebration of the department's centennial. According to Professor **Robert M. Fano,** '41, "life-long" implies "an uninterrupted commitment to formal education on the part of individual engineers"; and the adjective "cooperative" implies "the intermixing of work and study and the participation in teaching on the part of engineers, with the active support of their employers."

Associated with Professor Fano, who is chairman of the Centennial Study Committee, are Professors **James D. Bruce,** Sc.D.'64, **William M. Siebert,** '46, and **Louis D. Smullin,** S.M.'39. Together they intend to explore "the feasibility and implications of life-long cooperative education as a possible future pattern of education in electrical engineering and computer science," and eventually to plan an experimental program. The idea is "to respond to the rapid rate at which new basic knowledge is being generated and new technologies introduced, particularly in the electronics and computer fields," writes Professor Fano in a working paper prepared for the committee.

Plans for the Centennial celebration on October 1 and 2 are now being completed.

Andrea S. LaPaugh, Ph.D.'80, has taught at Brown University and has acted as a consultant to Bell Laboratories, Murray Hill, N.J., since the completion of her degree. She is presently an assistant professor at Princeton University. . . . **Robert J. Petrokubi,** S.M.'68, has opened a medical practice in gastroenterology in Rockport, Me. He is a member of the medical staff of Penobscot Bay Medical Center; his arrival marks the first time a gastroenterologist has joined the medical community in the mid-coast region. He received his M.D. degree from Johns Hopkins University in 1972, and for the following three years served an internship and residency in internal medicine at Pennsylvania State University where he taught from 1975 to 1981.

Avery H. Hevesh, S.M.'63, currently holds the position of principal staff engineer in the Reliability Engineering Department of the Raytheon Equipment Development Laboratory, Wayland, Mass. He is a senior member of the Institute of Electrical and Electronics Engineers (IEEE), past chairman of the Boston IEEE Reliability Chapter, and teaches courses in reliability, maintainability, and product assurance at Northeastern University's Center for Continuing Education. . . . **Robert Price,** Sc.D.'53, staff consultant of communications sciences at the Sperry Research Center, Sudbury, Mass., was the 1981 recipient of the Edwin Howard Armstrong Achievement Award bestowed by the IEEE. The award is given for outstanding contributions over a period of years in the field of telecommunications. Dr. Price's work focused on the fundamental analytical understanding as well as practical realization of digital communications and magnetic recording systems.

VI-A Program

Joining the list of prestigious companies participating in the VI-A Program this spring will be Analog Devices, Inc., Norwood, Mass., of which VI-A graduate **Raymong S. Stata,** '57, is president. Students will initially have assignments at Analog's semiconductor division in Wilmington, Mass. Ray was instrumental in the early functioning of the Massachusetts High Technology Council, having served as its chairman.

By the time this is read, all of our cooperating companies will have been on campus for the an-

Mobile Homes: A Good Solution Approaching a Big Problem

The first exposure of Thomas E. Nutt-Powell, Ph.D.'73, to the manufactured homes industry was when he was house-hunting in Altoona, Penn., in 1964, having just completed his undergraduate degree at Penn State. Conventional housing in Altoona was scarce and unattractive; then he went to a "trailer park," liked what he saw, moved in, and found the living "just fine."

It was more than ten years later that Dr. Nutt-Powell was asked by the Massachusetts Department of Community Affairs to make a study of the role of manufactured homes (trailers or mobile homes to most of us) in meeting Massachusetts' housing needs. It turned out to be a totally virgin territory; when he and his students went to talk to local housing groups they encountered blank stares, some "overt snickering," and almost no information at all.

Now that's been remedied by a formal research effort of the Joint Center for Urban Studies of Harvard and M.I.T. leading to the publicaton of *Manufactured Homes: Making Sense of a Housing Opportunity* (Boston: Auburn House, 1982, $21.95). Dr. Nutt-Powell's conclusion in his first book: "Manufactured homes present a real opportunity" to meet many of the country's current and future housing needs. The image of such housing as "cheap, flimsy, and unattractive, intended for undesirable markets . . . does not conform with the reality and . . . is no longer a sound basis for public-sector attitudes and programs."

nual VI-A interviews in March and will be deeply involved in the subsequent selection process. The program is still very popular and it's expected that about 180 students will apply for the approximately 85 openings the department will allow this year.

A VI-A alumnus, **Harold Chestnut,** '39, is the second recipient of the international Honda Prize. A fellow of the IEEE, of which he was president in 1978, he is currently systems engineering consultant for the General Electric Co. where he was manager of the Research and Development Center for many years. The award was for his leading achievements in electrical engineering and systems science, as well as his great efforts in promoting international cooperation in the field of engineering. Congratulations!

We sadly note the death of **David O. Woodbury,** '21. He was a noted author, teacher, and lecturer. Two important books he authored were: *Beloved Scientist (Elihu Thomson),* and *The Glass Giant of Palomar.*

Lawrence G. Walker, '73, a group supervisor at Hewlett-Packard Labs who nurtured a number of young VI-A's there, is now employed at Digital Equipment Corp., Hudson, Mass., where he will continue to interface with the program.

Visitors to the VI-A office have included: **Joseph P. DiLiberto,** '70, manager, advanced engineering/technology, Litton/Monroe Systems for Business, Morris Plains, N.J..; **Abraham Lederman,** '80, with Hewlett-Packard, California; and **Steven T. Kirsch,** '78, who has left Rolm Corp. to be a cofounder of the Whetstone Corp.—John A. Tucker, director, VI-A Program, Room 38-473, Cambridge, MA 02139

VIII
Physics

Norman Mazer, Ph.D.'78, writes, "After receiving an M.D. and Ph.D. from the Harvard/M.I.T. Health Sciences Program in 1978, I completed two years of medical residency training at the Peter Bent Brigham Hospital, Boston, Mass.This past year was spent abroad, doing biophysics research at the Eidgenossische Technische Hochschule ('the M.I.T. of Switzerland') and at the University of Lund in Sweden. My most enjoyable discovery in Europe, however, was meeting my wife, Marion, a native of Zurich." . . . **Edwin E. Kitner,** S.M.'46, who has just left his job as associate director for fusion energy in the Office of Energy Research at the U.S. Department of Energy, presented a detailed argument for the importance of fusion in making synthetic fuels at the 1982 AAAS meeting in Washington, D.C.

John B. Garrison, Ph.D.'47, a principal staff physicist at the Johns Hopkins Applied Physics Laboratory who retired in September 1981—after more than 30 years of service—passed away in November 1981. He specialized in missile guidance systems and radar technologies for part of his career and then in the applications of electronics to biomedical research. He was a member of the Space Department of the Applied Physics Laboratory at the time of his retirement, but for several years he was assigned to work with physicians of the Johns Hopkins Medical Institutions, working on the development of electronics for monitoring heart-wall contours and other phenomena.

X
Chemical Engineering

Robert A. Brown, assistant professor in the department at M.I.T., has been named the Mares Development Professor, a chair established in memory of **Joseph R. Mares,** '24. Professor Brown has been at M.I.T. since 1979, when he came from the University of Minnesota; his research interests include growing single-crystal metals as semi-conductors, the dynamics of fuel targets for fusion reactors, and the dynamics of fluid and gas flows.

A new career development professorship was established in chemical engineering late last year through the gifts of **Frederick E. Mangelsdorf,** S.M.'60, and the Texaco Philanthropic Foundation, Inc., in honor of Mr. Mengelsdorf's father, **Theodore A. Mangelsdorf,** '26. The honoree joined Texaco in 1933 and rose to be vice-president at the time of his retirement in 1966; he had been active in supporting M.I.T. as a member of the Corporation and through the Alumni Association, of which he was president in 1966-67.

Brian E. Thompson, a first-year graduate student in the department at M.I.T. who prepared at the University of Kansas, Lawrence, received first place in the $300 Student Contest Problem competition at the 1981 AIChE annual meeting last fall in New Orleans. Contestants were asked to design a continuous process to convert dichlorobutene to dicyanobutene during a 30-day period prior to the meeting; there were 44 solutions, of which a seven-man panel judged Mr. Thompson's to be the best.

Howard Brenner, former head of the Department of Chemical Engineering at the University of Rochester, has joined M.I.T. as Willard Henry Dow Professor of Chemical Engineering. Professor Brenner's work has been on theoretical aspects of fluid mechanics, notably the hydrodynamics of viscous fluids and heat and mass transfer in them. He studied at Pratt Institute (B.Ch.E. 1950) and New York University (M.Ch.E. 1954, D.Eng. 1957) and taught at New York and Carnegie-Mellon Universities before going to the University of Rochester in 1977. Professor Brenner holds the Alpha Chi Sigma Award (1976) of AIChE, of which he is a fellow, and the Bingham Medal (1980) of the Society of Rheology.

XI
Urban Studies and Planning

Samuel Mintz, M.C.P.'79, writes, "I have returned to the Department of Urban Studies and Planning and am completing a doctorate in the field of development economics. I also work and serve as consultant for Planning Innovations, Inc., based in New York City."

XV
Management

After 20 years at M.I.T., **Peter P. Gil,** associate dean, has accepted a new assignment as first dean of a new graduate school of management to be developed at Clark University, Worcester. Dean Gil came to M.I.T. to direct the Sloan School's Executive Development Programs and has been associate dean since 1966.

Jeffrey A. Meldman, '65 associate professor of management science who is chairman of the Sloan School's undergraduate program, now holds the additional half-time post of associate dean in the Office of the Dean for Student Affairs. Dean Shirley McBay says Professor Meldman's appointment "is a continuation of efforts to increase faculty involvement" in the Dean's Office; he will be chiefly involved in undergraduate academic support activities.

Dr. **Phyllis A. Wallace,** professor of management at M.I.T.'s Sloan School, has received the Samuel Z. Westerfield Award, presented by the National Economic Association to "a black economist who has achieved an outstanding record of accomplishments in the economics profession and the community at large." Dr. Wallace has served as senior economist in the U.S. government and as chief of technical studies for the Office of Research of the Equal Employment Opportunity Commission, and has published two books focusing on labor markets and discrimination.

Patricia R. Callahan, S.M.'77, has been named a vice-president of Crocker Bank, San Francisco, Calif. Prior to this appointment, she served as manager of the central adjustments and account reconciliation sections of Crocker's Northern California Operations Center and as manager of administration for the bank's operating division. . . . **Antonio C. Barbosa de Oliveira,** S.M.'77, writes, "I am currently a general manager at ITAU Technologia, Sao Paulo, Brazil, developing a business plan to establish an integrated circuit manufacturing facility in Brazil."

Technology and Policy Program

Paul Chernick, '78, is currently working for Analysis and Inference, Inc., Boston, Mass., a consulting firm. . . . **Bob Gillenwater,** '80, is continuing with law school at Boston College and is the proud father of twins, Michael and Viginia, born December 18, 1980. Gloria and Casey are both doing fine! . . . **John Stewart,** '80, is currently working for Teledyne-Geotech Service Systems, Alexandria, Va., on a computer system to process world-wide seismic data via satellite.

Roger Kilgore, '81, is presently working at Meta Systems, Cambridge, Mass., on an economic analysis of water pollution regulations. . . . **Robert S. Chen,** '82, has begun an eight-month appointment as a research scholar in the resources and environment area at the International Institute for Applied Systems Analysis, Laxenburg, Austria.—Professor Richard de Neufville, chairman, Room 1-138, M.I.T., Cambridge, MA 02139

Why that fierce look from James Olivieri, chief of the Campus Patrol? "The next student group caught on the roof of any Institute building without permission 'will pay the penalty'," he was telling Howard D. Trachtman, '85, of The Tech. *(Photo: Eric A. Sohn, '82, from* The Tech*)*

Off the Roofs—Even the Reindeer

The roofs of all Insitute buildings (except dormitories) were placed off limits to students by James Olivieri, chief of the Campus Patrol, early last winter, with a $50 fine on transgressors.

Mr. Olivieri cited "a significant increase in rooftop vandalism" as the primary reason for what *The Tech* called a "sudden policy change." He cited estimates of "tens of thousands of dollars" of damages from the Physical Plant Department—including broken doors, locks, and windows and the cost of removing bottles thrown down ventilation pipes. But Mr. Olivieri hastened to add that roof-walking privileges would be given to anyone "showing good cause."

With Christmas approaching, *The Tech* covered the situation with a verse to be sung to the tune of a favorite seasonal song:

You'd better watch out, and heed the new signs
The CPs have started roof hacking fines
Olivieri's going to town
It's fifty bucks now for special events
Olivieri's going to town
They're checking on the great dome
And not just for the view
If Santa's caught on Paul Gray's roof
They will fine the reindeer too

A Housing Crunch for Graduate Students

Far more than half of M.I.T.'s graduate students live off the campus, and many of them would choose on-campus living if housing were available. Indeed, after compiling questionnaire results from more than half of all graduate students enrolled in 1980-81, the Planning Office has concluded that nearly 700 single and married students would welcome on-campus housing if it could be had.

At least three reasons, according to the survey data:

☐ Off-campus housing is now more expensive than on-campus housing—a differential averaging $51 per month for single students and $142 for married students.

☐ On-campus housing is far more convenient. On the average, single graduate students living off-campus were 3.5 miles from M.I.T., married students 6.8 miles away. Seven percent of single students and nearly 25 percent of married students living off-campus were more than 10 miles from the Institute.

☐ On-campus housing is considered more secure. More than half the graduate students surveyed said safety and security were factors in their choice of housing, and 84 percent of single female graduate students cited this factor.

Nearly one-third of M.I.T. graduate students are now housed on the campus, with facilities for single and married students roughly in proportion to their populations. But turn-over rates are low because graduate students typically have long tenures at the Institute. Despite the fact that there are accommodations for 415 married students, there were no on-campus vacancies for married students entering the Graduate School last fall.

Indeed, concludes the Planning Office, "the Institute's aspirations for providing reasonable housing resources for its student have always outstripped the resources available to accomplish our objectives."

Puzzle Corner
Allan J. Gottlieb

Table for Seven, Please

Allan J. Gottlieb, '67, is associate research professor at the Courant Institute of Mathematical Sciences of New York University; he studied mathematics at M.I.T. and Brandeis. Send problems, solutions, and comments to him at the Courant Institute, New York University, 251 Mercer St., New York, N.Y. 10012.

Let me once again answer a perennial question: What criteria are used to select solutions for publication?

As responses arrive during the month, they are simply put together in neat piles, with no regard to their date of arrival or postmark. When it is time for me to write the column, I first weed out erroneous and illegible solutions. For difficult problems, this may be enough; the most publishable solution becomes obvious. Usually, however, many responses still remain. I next try to select a solution that supplies an appropriate amount of detail and that includes a minimal number of characters that are hard to set in type. A particularly elegant solution is, of course, preferred. I favor contributions from correspondents whose solutions have not previously appeared, as well as solutions that are neatly written or typed, since the latter produce fewer typesetting errors.

Problems

M/A1 Frank Model wants to know if the following contract can be made against any defense:

	♠ 7,3,2 ♥ 5,4,2 ♦ A,10,9,7,6	
♠ K,6,4 ♥ K,J,7,6 ♦ K,J ♣ K,Q,J,5	♣ 3,2	♠ 8 ♥ 9,8 ♦ 8,5,4,2 ♣ 10,9,8,7,6,4
	♠ A,Q,J,10,9,5 ♥ A,Q,10,3 ♦ Q,3 ♣ A	

The bidding:

South:	*West:*	*North:*	*East:*
1 spade	double	2 dmds.	—
3 spades	—	4 spades	5 clubs
5 spades	double	—	—
—			

M/A2 Arun Trikha has 39 balls of which 38 are identical in weight, but the 39th one is either heavier or lighter than the others. He needs to devise a method to isolate the "odd" ball with only four weighings using a balancing scale. The weighings should also establish if the odd ball is heavier or lighter than the others.

M/A3 Irving Hopkins asks the following question: Given the lengths of the n sides of an irregular polygon, how should the sides be arranged and what should the angles be in order to maximize the area?

M/A4 Jerry Griggs wonders in how many ways seven people can be seated at a round table so that no person sits next to the same pair (unordered) of people twice?

M/A5 Here is a problem posted on the M.I.T. Mathematics Department bulletin board as a promotion for the Math Club:
We begin with two integers m and n such that $2 \leq m \leq n \leq 99$.
We tell Mr. P. the product mn, and we tell Ms. S the sum m + n. The following conversation then takes place:
Mr. P: "I don't know the two numbers."
Ms. S: "I knew you didn't know. I don't know either."
Mr. P: "Now I know the numbers."
Ms. S: "Now I know, too."
What are m and n?

Speed Department

M/A SD1 Smith Turner has a tennis quickie. In a tournament of 32 entries, seven withdrew and were replaced by byes. When byes replaced two players bracketed to meet in the first round, a bye was advanced to the second round, etc. Assuming that the dropouts were scattered at random throughout the draw, what is the most likely number of matches that must be played to finish the tournament?

M/A SD2 Our last problem is from Phelps Maeker, who has a regular polygon of n sides and wants to know the ratio between the areas of the inscribed and circumscribed circles.

Solutions

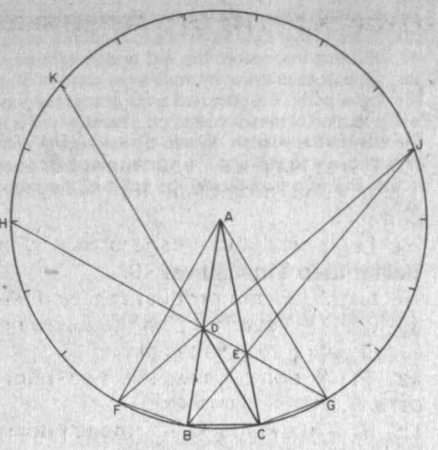
N/D 1 What is the shortest possible game of Othello?

Only Matthew Fountain responded; he writes: Stephen Kimmel reported the following game in the July 1981 issue of *Creative Computing* magazine. It occurred during a tournament involving four computer programs and one human.

	Flip disc		*Othello-instant*
1	D6		C4
2	F3		F6
3	E6		C6
4	C3		F4
5	F5		F2
6	C5		C2
7	E3		E2
8	D3		D2
Final Score	0	to	20

N/D 2 Using only plane geometry (not trigonometry), find angle EDC in the isosceles triangle ABC in the drawing, given EBC = 50° and BCD = 60°.

The following is from William Schumacher:
I felt intuitively (from appearances and from the difficulty of identifying another angle near that value geometrically) that the unknown angle was 30°, and set about to prove it. Several approaches involved constructing adjacent similar (including congruent) triangles and going through a maze of congruences, but in the end not only were they tedious but they were hardly rigorous enough to serve as proof. Ultimately the attached relatively simple and utterly convincing (I am tempted to say elegant) version emerged. The rationale:
1. Using A as a center and AB = AC as a radius, draw a circle.



2. On the circumference of the circle, lay out points F, G, H, J, and K, respectively 20°, 40°, 80°, 120°, and 140° from B; and alternately clockwise/counterclockwise from it, as shown.
3. Construct chords BJ and GH (120° each) and CK and FJ (140° each).
4. Chords BJ and CK subtend arcs of 120° and 140°, respectively, and define, versus chord BC (subtending a 20° arc), base angles at B and C of 50° and 60° respectively in triangle ABC, corresponding to the problem statement.
5. Chords BJ and GH, subtending arcs of 120° each and symmetrically disposed about radius AC, intersect at point E on AC.
6. Chords FJ and CK, subtending arcs of 140° each and symmetrically disposed about radius AB, intersect at point D on AB.
7. Line segment DE is therefore one side of the unknown angle EDC or GDC, and with its vertical angle HDK the two angles subtend arcs CG (20°) and HK (40°) for a total of 60°. The angles EDC and HDK are therefore each 30°.

Also solved by Matthew Fountain, Harry Zaremba, Winslow Hartford, Ronnie Rybstein, John Woolston, Allan Gifford, Greg Huber, John Rule, F. Farassat, Emmet Duffy, and the proposor, Craig Murphy.

N/D 3 Ask a friend to write down *any* number B. Above B, write another number A, made up of all the digits in B *and any additional digit except O*, arranged in *any* order. Subtract B from A. Ask your friend to tell you the final answer, C. For example,

A 65,835
B 5,653
C 60,182

You can find the unknown added digit (8 in the example) as follows: add together the digits of C, and if this result contains two or more digits, add these together in turn, and so on, until only one digit remains. This will be the extra digit that was added in forming A. Why?

Emmet Duffy solved this easily. He writes:
This problem is nothing but casting out nines. If you add the digits in a number and, if the result is more than one figure, continue to add digits in the sum until only one digit remains, the same result will be obtained by casting out nines except that if the number is a multiple of nine, casting out nines will yield a result that is zero, but adding up the digits as in the puzzle will result in a nine, which is then cast out. Calling the number which remains when nines are cast out the digital number, which will be called a, then if any four-digit number has a digital number a, and if a digit b is included with the four digits to make a five-digit number, then the digital number will be a + b if this is one digit or a + b – 9 if the sum of a + b is a two-digit number. Using the cast-out-nines method to check subtraction, we subtract the digital number of the minuend from the digital number of the subtrahend to get the digital number of the remainder. If the digital number of the subtrahend is less than the digital number of the minuend, then add nine to it before subtracting. In either case the digital number of the remainder will be the digit b.
Case 1: a + b is one digit; then a + b – a = b, the digital number of remainder.
Case 2: a + b is a two-digit number; then the digital number of subtrahend will be a + b – 9. This will be smaller than the digital number of minuend. Then before subtracting a 9 is added making the result: a + – 9 + 9 – a = b.
The advantage of adding up the digits instead of casting out nines is that in case the added digit b is 9, the result will be 9, not 0.

Also solved by Ronnie Rybstein, Frank Carbin, Winslow Hartford, Harry Zaremba, Matthew Fountain, and Angel Silva.

N/D 4 Given the one known digit, as shown, fill in all the xs:

```
      xxxx
√xxxxxxxx
 x
 xxx
  xx
  xxxx
  xxxx
   xxxxx
   xxx3x
```

Norman Wickstrand presents a lucid explanation:
By inspection, the first digit in the root is 3. The trial divisor for the next digit is then 6x. Since 62 x 2 is a three-digit number, the second digit must be 1. 1xx – 61 is greater than 3900. 3900 ÷ 62x is greater than 6. Hence the third digit is 7, 8, or 9. By inspection the fourth digit cannot be 0 or 1. We have only 24 choices left, all of which we must try. They are 634x • x, and 636x • x, and 639x • x. The only one which has 3 for the next-to-the-last digit is 6384 • 4. Hence the desired root is 3194, whose square is 10,201,636. Incidentally, instead of the digit 3 the digits 1, 5, and 9 also give unique solutions for similar problems.

Also solved by Angel Silva, Harry Zaremba, Matthew Fountain, Winslow Hartford, Ronnie Rybstein, John Woolston, Harry Hazard, Mary McKenockett, Mike Bercher, Carl Seils, Emmet Duffy, Marshall Fritz, W. McGuinness, Richard Celotto, Sandra Zack, and Dennis Sandow.

N/D 5 Given that red columbines produce an average of 100 seeds per pod (with a normal distribution, standard deviation = 10), and yellow columbines produce an average of 99.8 seeds per pod (also with a normal distribution, standard deviation = 10). The number of red plants equals the number of yellow plants, and all plants bear the same number of pods. I might collect only those pods with 110 or more seeds. Alternatively, I might collect all the pods with 110 or more seeds, 90 percent of the pods with 109, 80 percent of the pods with 108, 70 percent of the pods with 107, etc. Whatever I do, the proportionate deficiency of yellow seeds will be approximately equal to the product 0.01•0.2•i, where i is the average number of seeds per collected pod minus 99.9. Show that this last statement is correct.

Harry Zaremba sent us the following solution:
Based on the given data, the standard deviation of seed distribution in the combined seed population must also be equal to 10, and the magnitude of the ordinates in the normal distribution curves for the separate and combined seed populations will be identical. As a consequence, the mean number of seeds in the pods of the total population will be
m = (100 – 99.8)/2 = 99.9,
and the number of seeds that the average number of seeds collected per pod (m_c) is in excess of the total population mean is equal to
$i = m_c - m = m_c - 99.9$.
Further, the average number of yellow seeds less than the average number of red seeds per mean number of seeds in the total pod population is given by
d = (100 – 99.8)/m = 0.2/m.
Hence the deficiency D of yellow seeds in the collected group of seed pods is
D = di = (0.2/99.9) i = 0.01 • 0.2 • i, approximately.

Meanwhile, Matthew Fountain comments on the problem itself:
The statement of **N/D 5** glosses over the probability aspect of the problem. The red columbines and the

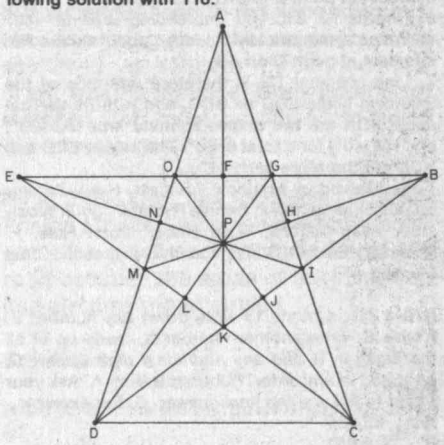
yellow columbines have so closely identical seed distributions that even were one to randomly select 10,000 pods from each, the red pods might have the same or even lower average seed content than the yellow pods. The standard error of the mean for a distribution of means based on a sample size n is the standard deviation divided by the square root of n. With $n = 10{,}000$ and $\sigma = 10$, the standard error is 0.1. But I do understand the spirit of the problem.

Better Late Than Never

Y1981 Harry (Hap) Hazzard notes that
$71 = 81 - 9 - 1$
$72 = 1 \bullet 81 - 9$
$80 = 81 - 1^9$
giving us a total of 58 numbers.

MAY3 Walter Nissen has responded.
A/S3 Mitchell Serota and Johan Norvik have responded.
A/S4 William Moody has found that the exact answer is $6\sqrt{10}$.
A/S SD1 Jack Page notes that he used this problem in an article he wrote for Technology Review (July/August, 1972).
OCT2 George Flynn has responded.
OCT3 Walter Nissen has responded.
OCT4 Matthew Fountain has responded.
OCT5 Walter Nissen has responded.

N/D SD1 Hank Ferguson and Sandra Zack found 109 triangles and W. McGuinness sent us the following solution with 110:



		CDG			
		CDI			
ACD	BDG	CDJ	DGI	EFK	FGP
ACK	BDM	CDK	DGO	EFP	FOP
ACM	BDO	CDL	DIG	EFI	GHP
ACO	BDP	CDM	DIN	EGL	GIP
ACP	BEI	CDO	DIP	EGP	COP
ADG	BEK	CDP	DJO	EIK	HIP
ADI	BEM	CEG	DJP	EKP	IJP
ADK	BEP	CEI	DKL	ELP	IKP
ADP	BFK	CEO	DKM	EMN	JKP
AFG	DFP	CEP	DKP	EMO	KLP
AFO	BGH	CGL	DLM	EMP	KMP
AGO	BFI	CGO	DMP	ENO	LMP
AGP	BGP	CGP	DNP	EOP	MNP
AHM	BHI	CHM	DOP		MOP
AHP	BIP	CHP			NOP
AIK	BJO	CIJ			
AIN	BJP	CIK			
AIP	BKM	CJK			
AKM	BKP	CKD			
AMP	BMO	CKP			
ANP	BOP	CLP			
AOP		CMO			
		CMP			

Proposers' Solutions to Speed Problems

SD 1 There are always 24 matches, one player eliminated in each.
SD 2 $\cos^a(\pi/n)$.

Under these conditions, each controller's screen will contain a large number of points indicating the most recently detected positions of aircraft, without the normal computer-generated identity, speed, altitude, or conflict alerts. The controller uses plastic markers to show identifying information, acquired through radio contact, about each aircraft. As the dot indicating the position of the aircraft moves, the controller must move the appropriate marker in unison.

Identification of aircraft is especially difficult when they enter the edge of the controller's area during such a computer failure. After several near-collisions and persistent demand from controllers, the FAA augmented this backup system to display the identity and approximate altitude of all aircraft that carry a special transponder. However, not all aircraft do, and more complex functions, such as conflict alert, are still not available during computer failures.

Outmoded Computers: The Achilles Heel of NAS

Apart from reliability, there are other problems with the present NAS system. To explain these, we review the five primary functions at each ARTCC. They are:

Flight data processing. This function automates clerical and manual tasks relating to flight-plan data. Flight plans for regular commercial flights are automatically processed; those for other flights may be entered by air-traffic controllers, airport control tower operators, or airline personnel. The NAS computers then print flight strips showing the source, destination, route, and scheduled times of each flight. These are automatically distributed by the computer to appropriate controllers as each aircraft enters a controller's jurisdiction, supplementing the information on the controller's screen.

Radar data processing. Data on radar targets, including information on the identity of each aircraft and its altitude, are fed into the computer from primary and secondary radar sites for display to controllers and automatic tracking. The main system can combine inputs from two or more radars (a "mosaic"), but the backup system cannot.

Tracking. The computer uses radar data to calculate the direction and speed of an aircraft and determine its likely future position and potential conflicts. For those aircraft with prefiled flight-plan data, the computer can also provide information such as proposed routes and type of aircraft to controllers, enabling them to supervise deviations from planned routes. If two or more aircraft are projected to come too close, a "conflict-alert" signal is generated. Finally, "automatic handoffs" of aircraft between sectors enables control to be transferred from one air-traffic controller to another with minimal effort.

The effects of the software rehosting program to replace today's obsolete air-traffic control computers with modern units. There will be significant increases in capacity and reliability as well as speed, despite projected increases in the volume of air traffic.

	Present (IBM 9020)	1985	1990	1995
Units of aircraft flying (1981 = 1)	1	3.5	4.5	5.5
Percent of CPU computer capacity utilized	0.73	0.52	0.66	0.81
CPU response time (seconds)	2.26	0.087	0.123	0.224
Overall system response time (seconds)	6.73	0.239	0.357	0.845

Generation of displays. The computers give each controller appropriate visual information continuously. Controllers also have keyboards and other devices for requesting updated data or different display formats from the computer.

Computer system monitoring. The central computer complex manages resources within the 9020 system, whose computers are organized as redundant two- or three-processor systems, deleting malfunctioning units, bringing additional redundant units online, and providing overall control over resources and jobs.

One design criterion of the present National Airspace System was that computer response time should be less than two seconds—that is, the data put into the system or requested by a controller should be available on the display screen within two seconds. But air traffic has increased at a rate of over 4 percent a year since the design of the NAS, and at times of peak load the response time of the 9020 system is as high as seven seconds, despite the fact that noncritical functions are delayed for later processing.

As the amount of traffic increases, so does the

"Rehosting:" a practical alternative to the ideal of starting from scratch.

memory requirement. Each new software release, being larger than the previous one, requires still more memory space. Indeed, as the utilization of any such computer system increases, there is a higher-than-proportionate increase in response time; as utilization increases above 70 percent, the response time degrades exponentially. Today utilization of the central computer complex frequently exceeds 90 percent of capacity at times of peak traffic.

Because the 9020 computers are based on a level of technology almost 20 years old, maintenance problems abound: subsystems malfunction and the overall system must operate in degraded modes for extended periods of time. Many spare parts are no longer available—some must be specially manufactured. For example, the FAA recently signed a contract with IBM for the supply of additional memory modules at a price several times higher than that of current memory units. Such costly spare parts will increasingly be needed, and the useful lifetime of the 9020s will end around 1990 or even earlier.

Two options are available to deal with this problem. One is to restrict air traffic to a level that the current system can handle. In fact, the air-traffic controllers' walkout forced the exercise of this option by causing a restriction of air traffic, but this is obviously not a satisfactory long-term solution.

The alternative is to increase computational power. This approach offers other advantages, too. Today air-traffic controllers' screens provide information on the identity, speed, altitude, and physical position of all aircraft. But the system gives the controllers no information about each aircraft's destination and little information on weather conditions; both must be included in any future system. Because human beings cannot easily visualize in three dimensions the future positions of aircraft moving in different directions, especially if they are ascending or descending, computers should also take over this task.

Furthermore, to minimize the difficulty of coordination and communication among controllers, the present system forces aircraft to fly along "highways" and on specified climb/descent profiles instead of on direct routes. A new generation of air-traffic control equipment could include far more automation of aircraft routing to minimize intervention by controllers and permit direct flight routes. Indeed, a large portion of the functions that cause stress and fatigue for controllers could be transferred to computers. Under these conditions, each controller could handle a larger area and more flights.

Managing the Transition

If one could start from scratch to build a new air-traffic control system, it would be based on contemporary hardware and software. Today's inexpensive microprocessors are so powerful that each offers computational capabilities comparable to those of the 9020. New interconnection methods would permit integration of up to 100 or even more such microprocessors, providing very large computing power and high system reliability and resilience. Finally, new management techniques are available for quick storage and retrieval of large volumes of data, and software development would be structured accordingly. This would mitigate all the creeping inefficiencies and capitalize on the potential of the latest technology.

But a complete replacement of the existing system would involve major investments in hardware and software; the latter would be especially costly and time-consuming, making this option very difficult to achieve for the 1990 deadline. Therefore, the FAA has examined various incremental options that could enhance the computing power and memory capacity of the present system while eventually becoming part of a full replacement system. These would include contingency options in case the current computers encounter serious problems before a full replacement is ready—a distinct possibility.

One alternative is to add a separately programmed auxiliary processor to augment computing power. Although this option appears feasible, current software is not capable of running tasks on several loosely coupled processors. Even if software is modified to allow an auxiliary processor to assume an entire function, such as flight or radar data processing, each function would require high-speed access to the main NAS computer system.

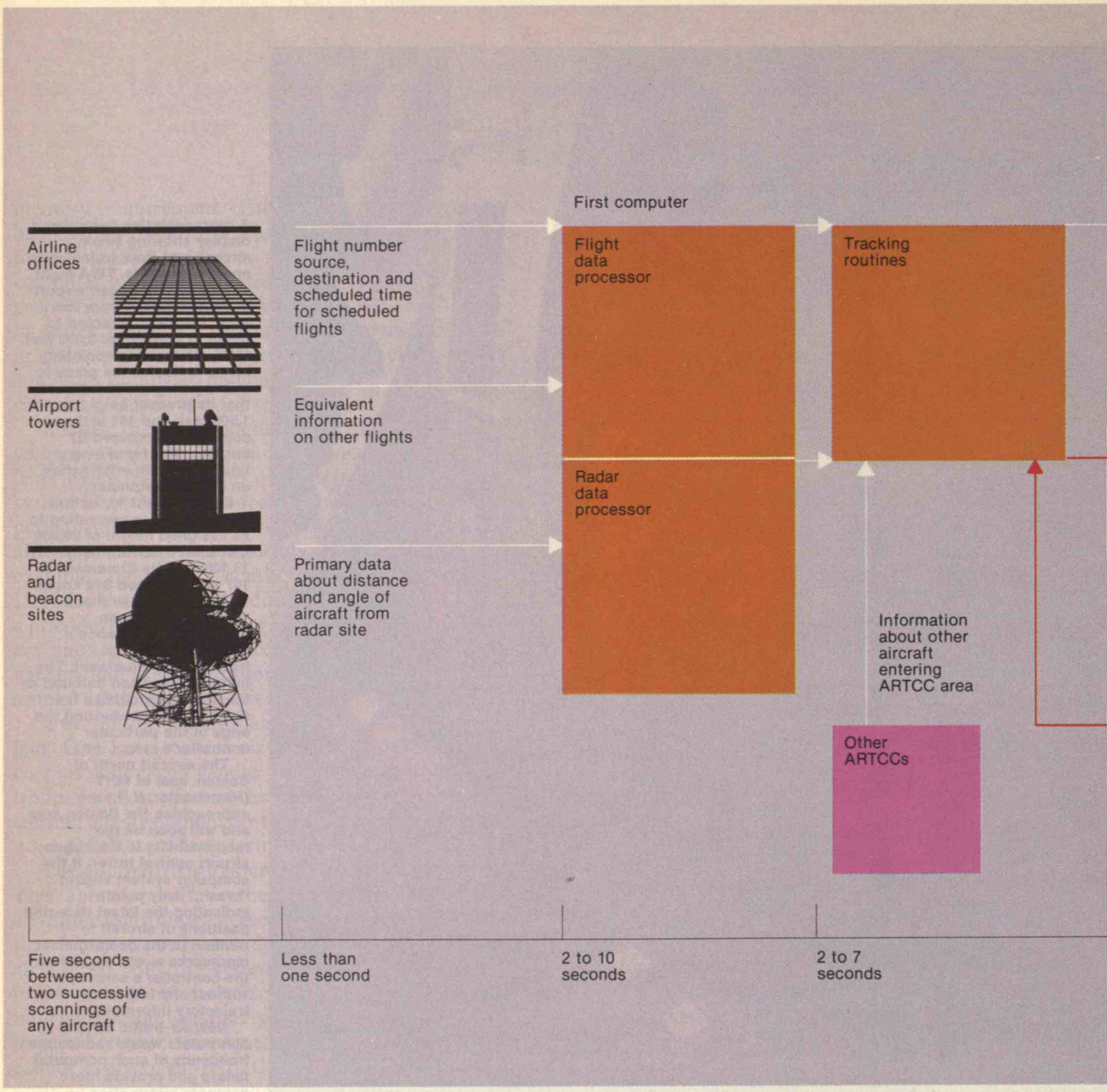
Another alternative is to replace selected pieces of existing hardware with modern off-the-shelf hardware that is faster but functionally similar and operates with existing software. This option—called "rehosting"—would provide higher overall capacity, sig-

A representative controller's display showing seven aircraft and their trajectories and five airports. TWA flight 121, departing Logan airport in Boston (BOS) from the west, has been directed to climb to a height of 3,000 feet (030). The upward-pointing arrow indicates the plane is gaining height, 016 indicates that its present height is 1,600 feet, and 141 is the computer-generated ID number. The remaining figures contain information on beacon frequency.

Eastern flight 11, farther from Boston, is ascending to an assigned height of 26,000 feet from a current height of 13,100 feet. Its ID number is 107 and its speed 310 knots. "HAND" indicates that a "hand-off" between controllers, and hence a change in assigned frequency, is imminent. The hand-off has been initiated as the plane approaches the dotted line representing the edge of the particular controller's area.

The aircraft north of Boston, east of MHT (Manchester, N.H.) are approaching the Boston area and will soon be the responsibility of the Logan airport control tower. If the computer system should "crash," only points indicating the latest detected positions of aircraft in relation to the geographical landmarks would appear on the controller's screen, without any textual or trajectory information.

New air-traffic control computers would reduce the frequency of such computer failure and provide more accurate information on aircraft positions. New computers could assume many of the functions now performed by controllers, and aircraft could use the entire airspace (rather than a few "highways"), thus following direct routes and increasing fuel efficiency.



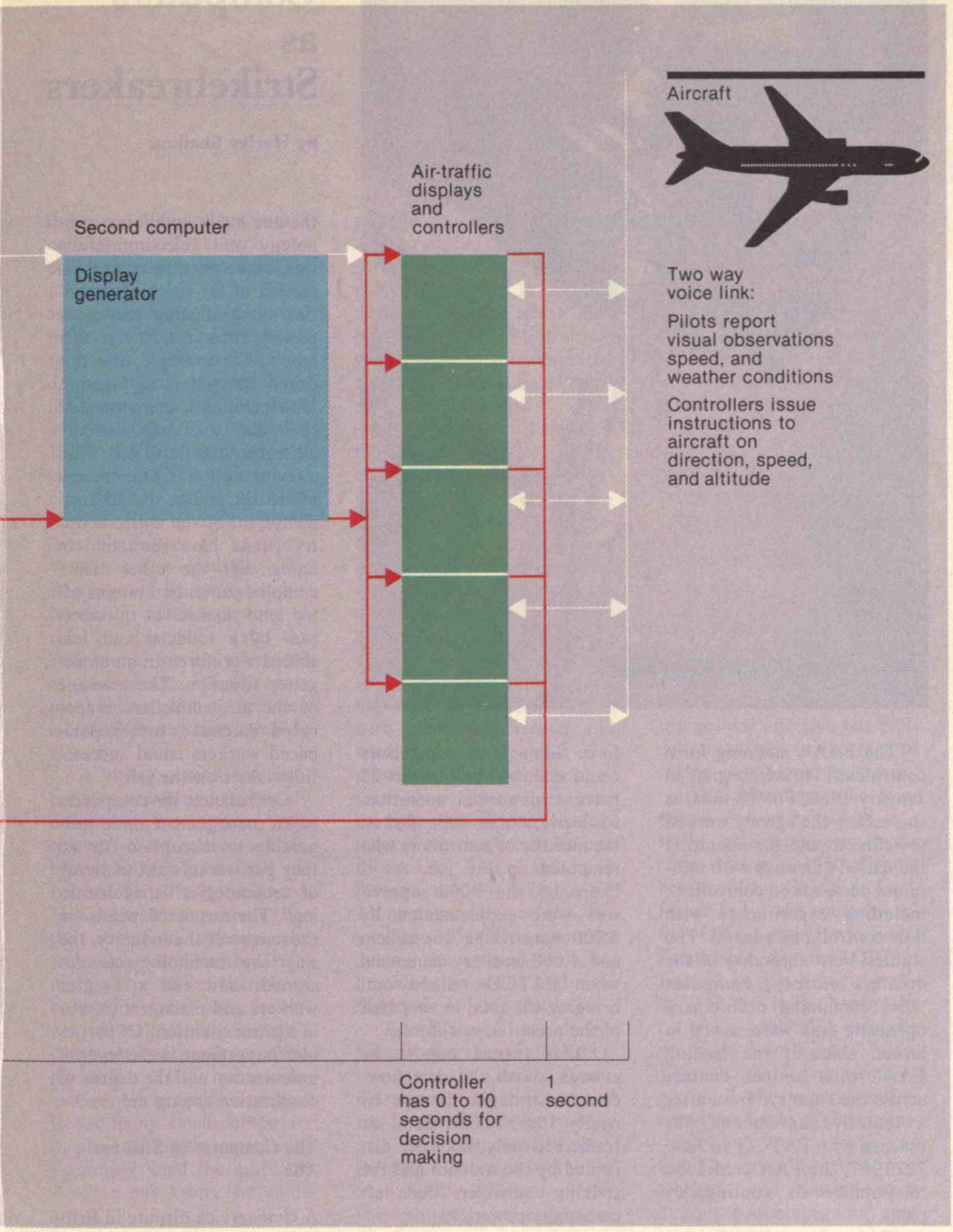
nificantly reducing response time below today's worst cases with minimal software modification. Indeed, such a solution offers four advantages:

☐ The newer technology would allow an increase of 3 to 10 times in processing speed, as well as an order-of-magnitude increase in storage capacity and the number and capacity of input/output channels. Current mainframe computers can execute 6 million instructions per second, a factor-of-ten increase over the existing 9020 system in computing speed. This would allow for increased air traffic and future software enhancement, such as automated routing, to give controllers more information and the system itself a larger role in decision making and communication.

☐ These gains could be achieved quickly, avoiding the lengthy, expensive process of rewriting software.

☐ Reliability and maintenance problems would be eliminated because the 9020s themselves would be replaced.

☐ The special instructions of the 9020s would be



The flow of information to, in, and from a typical air-route traffic control center (ARTCC). Airlines and airport officials provide flight plans. Current data on aircraft in the ARTCC's airspace are received from radar, and data on aircraft entering the ARTCC's airspace are supplied by neighboring ARTCCs. These inputs are processed in central computers to yield displays showing aircraft locations, identities, and trajectories for controllers, who are in charge of aircraft movements throughout the ARTCC airspace.

The critical issue is how quickly the central processor can translate radar and beacon data into location and trajectory information on controllers' display screens, and how quickly the computer can respond to controllers' questions and instructions (through the feedback loop shown by the red arrows). When the present system was designed, computer response time was not to exceed two seconds. But aging equipment and increasing traffic now result in response times of as much as seven seconds.

eliminated and only basic instructions compatible with today's mainframe computers would be used. Thus, the new system would allow gradual, modular development of the full NAS software replacement system.

The technical details of such a "rehosting" are by no means extraordinarily difficult. A 90-day parallel operation of an old and new system could insure that the transition from existing computers to any new system would be smooth and trouble-free so that safety would not be jeopardized. Such an intricate transition will be relatively easy if the new system is totally independent of the old system. If the systems use common subsystems simultaneously, special interconnecting mechanisms will be required, but these, too, are within present technology. This "rehosting" program—the use of existing software in current-generation computers—would cost $250 to $300 million.

(*Continued on page 54*)

Computers as Strikebreakers

by Harley Shaiken

THE situation on August 3, 1981, had the makings of an epic confrontation: over a decade of bitter and often turbulent labor relations in the nation's air-traffic control system burst into public view as the Professional Air Traffic Controllers' Organization (PATCO) went on strike. The Reagan administration, determined to thwart a walkout of public employees, gave the strikers 48 hours to return to work or face permanent dismissal. The resources and muscle of the federal government were arrayed against a tiny union that threatened to cripple air transport throughout the United States. So the battle ended almost before it was joined in a rout of PATCO that included the firing of 12,000 air-traffic controllers and the decertification of the union.

PATCO was weakened by a lack of public support, lukewarm aid or even hostility from other unions, its own inexperience, and a tough adversary. But what ultimately doomed the union was the government's skillful use of a new weapon—computer technology—to keep air traffic moving, gutting the strikers' leverage. Soon after the walkout occurred, 75 percent of commercial flights were operating in spite of the fact that some 75 percent of the air-traffic controllers were on the picket line. The centerpiece of the Federal Aviation Administration's strategy was "flow control," a computerized procedure to regulate departures to space aircraft uniformly along air-traffic routes, thus maximizing the use of airspace, facilities, and controllers.

The FAA's planning for a controllers' strike began in January 1980. For 18 months thereafter, the agency worked to refine a plan for operating the nation's airways with minimum demands on controllers, including experiments with flow-control procedures. The studies were shrouded in the greatest secrecy; computer tapes containing preliminary operating data were stored in locked safes at the leading FAA route-control centers across the country. Even after a tentative agreement was reached with PATCO on June 22, 1981, the FAA continued to improve its contingency plans.

Computers reduce but do not eliminate the need for air-traffic controllers. So during the planning period, supervisors were requalified as controllers so that they could become the core of a group to replace the controllers should there be a strike. But one early study indicated that a workforce limited to supervisors could maintain only about 25 percent of normal operation, so clearly success depended on the number of controllers who remained on the job. As it happened, the 3,000 supervisors were supplemented by 5,700 nonstriking controllers and 1,000 military personnel when PATCO walked out, bringing the total to over half of the prestrike workforce.

This turned out to be enough. With the new flow-control strategies in use by nearly 10,000 controllers, air traffic was only modestly disrupted by the walkout and the striking controllers were left essentially powerless.

How Strong Is Technological Strikebreaking?

The story of this dramatic confrontation underscores the potential importance of computers in labor-management relations in general and strike situations in particular. On the one hand, computer technology and telecommunications make possible central direction of far-reaching activities, concentrating enormous power into relatively few hands. For example, the few dozen controllers in Gander, Newfoundland, demonstrated their ability to halt virtually all trans-Atlantic flights. Had a few more PATCO members joined the strike, the air-traffic system of the entire country would have been tied in knots. On the other hand, complex computer systems often lend themselves to operation by a reduced and less skilled workforce in an emergency situation. The leverage of the air controllers evaporated because less-experienced workers could successfully take over the job.

On balance, do computers make management more vulnerable to disruption, or do they put workers at the mercy of technological strikebreaking? The answer depends on the nature of the industry, the way the technology is designed, and the strategies workers and managers pursue in a given situation. Of particular importance is the level of unionization and the degree of cooperation among unions.

The Computer as Strikers' Ally

A civil-service dispute in Britain in the spring of 1981 illustrates how a small number of workers can use computers to paralyze an enormous bureaucracy. The civil-service unions challenged the government in a pay dispute, not by pulling out hundreds of thousands of workers in a direct confrontation, but by with-

drawing 3,500 workers at tax-collection centers who use computers to process Britain's national sales tax. Vast amounts of financial pain were inflicted with minimal resources in a few months by a devastating campaign of guerilla warfare. In the first week of the strike, for example, 1,200 strikers reduced the government's revenues from a normal $550 million to $105 million, even though supervisors continued on the job. Within a few months, labor stoppages had delayed between 25 and 45 percent of the government's sales-tax collections, forcing emergency borrowing; 370,000 payment checks piled up, creating a mess that may take a year to clear up.

A highly centralized computer system and a highly unionized workforce, with strong ties to related unions, proved to be a formidable adversary for the government. However, management has the power to redesign the technology, and in the aftermath of the strike, there have been widespread calls for decentralization of Britain's computer system. One spokesperson for a U.K. trade association, advising its members to use many small computers in place of highly centralized systems, coined the quip "an Apple a day keeps the union away."

Computers on the Management Side

On the other hand, computers give management some unique options, too. In industries as diverse as newspapers, insurance, and manufacturing, the ability of computers to provide continued operations with a reduced or fill-in workforce—often composed of people with fewer skills—can devastate a union effort. And it is often possible to transfer work out of a location that is on strike—what unions might term "telescabbing."

A bitter labor dispute at the *Washington Post* in the early 1970s provides an example of the strikebreaking potential of computer-based machinery. Determined to free itself from restrictive union work rules, the *Post* made extensive preparations to keep its newly installed printing equipment running during a strike. This included importing executives from papers with strike experience and sending 55 white-collar employees to a special school to learn how to operate new presses, the automatic features of which were an issue in the strike. Those automatic features made it possible for 33 managers to perform the jobs of 205 press operators during the ensuing walkout, breaking the strike and ultimately destroying the union.

Another confrontation between printers and publisher, this one at the *London Times*, illustrates both the power and the limits of high technology in a strike situation. Midway through a one-year lockout of over 3,000 workers in 1979, the paper's management sought to resume publication. The plan was to compose the paper in London, beam it to Frankfurt, West Germany, for printing in a nonunion shop, and then airlift it back to Britain. While the cost would have been prohibitive in the long run, the hope was that the unions' morale would be sapped in the short run, thus forcing an end to the dispute.

The unions, however, had a different idea. They counterattacked by flying a delegation to Frankfurt that successfully persuaded the city's Central Labor Council to take strong sympathy actions. Despite the fact that the printing plant was nonunion, the ensuing uproar caused it to cancel its arrangements with the *London Times* after a single issue.

Had PATCO received similarly active support from other unions in the air transport industry, the balance of power would have changed considerably. The short-lived job actions that did take place overseas proved effective but difficult to sustain in the face of strong government pressures.

The advantage that computers give management in a strike situation was made clear during a 1980 dispute between Blue Shield of California and 1,100 members of the Office and Professional Employees Union (OPEU) Local 3 in San Francisco. As the 133-day strike began, the company adopted a carefully prepared contingency plan. This plan included assigning all available supervisors to computer banks in the claims-processing area, hiring and quickly training 350 new workers, and routing some claims processing to nonunion offices as far away as Los Angeles. The various offices were linked together through computers and telephone lines irrespective of picket lines. In addition, training the new workforce was made far easier because computers had been used to simplify tasks. As a result, Blue Shield asserted that it was able to maintain near-normal operations with far fewer workers. After the strike, the company refused to return 448 jobs to the main office.

Even manufacturing is affected by computers. Numerically controlled machine tools allow complex parts to be made by relatively unskilled workers; the skill is contained in a computer program rather than the machinist. In a strike situation, experienced supervisors can help workers with very little background in machining do the work of strikers. Although the process can be inefficient and often produces considerable scrap, it can serve to pressure unions toward a settlement. Alternatively, the programs containing machine instructions can be beamed halfway around the world to escape a strike.

In simpler times, John L. Lewis—the fiery president of the United Mineworkers Union—told a president who sought to break a miners' strike that "you can't mine coal with bayonets." That still may be true, but computer technology allows more and more processes to be operated by supervisors and other fill-in workers during a labor dispute. Does this mean that John L. Lewis' strategy is outmoded and that the strike is finished as labor's ultimate weapon? No. But it means that unions will require broader strategies and more technical sophistication to effectively use the strike as a weapon in the future. □

Harley Shaiken is a research associate in the Program in Science, Technology, and Society at M.I.T.

How Pilots Will Be Partners in Air-Traffic Control

by Andrew Pollack

PHOTOGRAPH: RICK SMOLAN, STOCK BOSTON

In what would be one of the largest nonmilitary projects ever undertaken by the nation, the Federal Aviation Administration (FAA) has proposed a 20-year, multibillion-dollar overhaul of the aging air-traffic control system. The program would replace ground control computers, now subject to breakdowns because of increasing demands on their services, with newer, faster machines designed to improve safety while using fewer human supervisors.

As significant as this revamping of the ground system is the proposed transformation in the air. Computer automation will enter the cockpit, bringing about vast changes in the roles of ground controllers and pilots.

The agency plan envisions shifting some responsibility for air-traffic control from the ground to the plane, a redistribution advocated by pilots that seems to have won acceptance by the agency's new chief, J. Lynn Helms. "He's redefined the ground task and the air task," said John E. O'Brien, manager of engineering and operations for the Airline Pilots Association. "The idea that the ground should do everything is dead as long as Helms is around," said George B. Litchford, an aviation systems consultant in Northport, Long Island.

Computers versus Pilots?

But a transfer of responsibilities from ground to air based on cockpit automation will bring with it a transfer of responsibilities from pilot to onboard computers. Pilots will spend less time flying the plane and more time monitoring how the computers do it. Jobs are also at stake. A presidential task force has already decreed that the automated planes scheduled to begin service in the next few years—the Boeing 757 and 767 and the European A310 Airbus—will require two pilots, not the standard three.

Initiating cockpit automation are advances in technology that allow what were once room-size computers to fit in a shoebox, sometimes on a silicon sliver the size of a fingernail. In the Boeing 757 and 767, computers will help throttle engines to insure fuel efficiency and will take over navigation tasks. "A lot of information pilots used to carry in a briefcase and leaf through will be available in the computer," said Jack J. Hatfield, a cockpit engineer at NASA's Langley Research Center in Hampton, Va.

The planes will also use computer screens to replace some of the needles and dials that make today's cockpit such an apparently confusing place. The new cockpit will offer flight information in a central location and a more readily understandable form. Pilots will be able to track their plane's course over a changing map, much as in a video game. "In the next decade, we will get to a cockpit that has only CRT displays," predicted Donald K. Burkholder, manager of airline marketing for Sperry Flight Systems.

The same electronics and display technology could create a new air-traffic control system in which pilots watch the traffic around them on screens while onboard computers calculate whether the other aircraft are getting too close. However, flight responsibilities are not likely to change overnight. Even now, there is concern that overreliance on either pilots or computers could diminish safety rather than enhance it.

Pilots today have responsibility for seeing and avoiding other planes in good visibility. In bad weather, they rely on voice commands from the ground with little idea of why the commands are given. Pilots deride the system as an "electronic train" approach.

The first step toward increasing onboard control, and the only one favored by the government thus far, is a last-ditch collision-avoidance system. In this plan, a plane's radar would gather information on nearby aircraft. If a collision appeared imminent, the computer would sound an alarm or flash an instruction such as "CLIMB." Federal authorities are testing the system and hope to approve its general use by 1984. It will not be mandated, however.

The next step would be to let pilots see the surrounding air traffic but not allow them to act on the information. In this way, pilots could check up on ground control. Some observers fear this system might also overwhelm them with information. "Pilots are very busy on final approach—if you give them a lot of data you can confuse them," said Clyde Miller, FAA program manager for aircraft separations.

A still more advanced system might have pilots acting, within limits, on the information displayed on their screens. Should ground control tell one plane to stay two miles behind another, it would then be the pilot's job to monitor and maintain the separation. Similarly, pilots could take the initiative to merge with others into a single lane to approach a runway.

Traffic Cops and Failure Modes

Mr. Litchford, who has designed collision-avoidance systems, argues that giving pilots such responsibility could ultimately benefit the nation's air transport system, since the immediacy of onboard control would allow closer spacing of airplanes and a consequent increase in traffic flow and fuel savings. It would also further decrease the number of ground controllers. Most experts say that some centralized ground control will always be needed, however. "There must still be a traffic cop," said Siegbert B. Poritzky, director of the FAA Office of Systems Engineering Management.

Overreliance on machines presents its own problems. As computers take on more tasks on the ground and in the air, the potential effects of computer failure become more catastrophic. Using several computers and dividing responsibility between the ground and the air can minimize the risks but won't eliminate them entirely. There is also danger in the computers breaking down only rarely: pilots and controllers could grow rusty, Mr. Poritzy observed, losing the ability to maneuver manually when a breakdown does occur. □

Andrew Pollack, who reports on technology for the New York Times *financial section, studied engineering at M.I.T. This article is reprinted by permission*

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the entire task of routing air traffic will be done
with little human intervention.

Automation Power
(*Continued from page 49*)

Early this year the FAA proposed revamping the air-traffic control system based on this option. The FAA proposals represent far-reaching changes in all domains of air-traffic control to take into account the high cost of fuel, the increases in air traffic, the need for improved safety, and all current technological innovations. These changes will be accomplished over a 20-year period. The program will begin with "rehosting" today's programs in a new generation of faster, more versatile computers to augment the computing power of the central computer complex. The display generators will be replaced by multiple minicomputers that will provide more computing power and higher reliability.

Modernization of computing equipment would be matched by modernization of communication facilities. A new system called DABS (discrete address beacon system) will transmit computer-generated instructions directly to the aircraft, where they will be displayed visually and audibly using speech-synthesis techniques. This will reduce the need for and duration of voice communications between pilots and air-traffic controllers, thus enabling the air-traffic control system to handle more traffic with a reduction in facilities and personnel. Indeed, the productivity of each controller is expected to double, the overall staff reduced by one-third, and the number of air-traffic control centers reduced from 20 to 16.

The redesigned software will permit automation of new functions. Between 1989 and 1995, an automated en-route air-traffic control (AERA) facility will be implemented to carry out normal routing and conflict-avoidance without controllers' intervention. AERA will assign flights to the most direct, fuel-saving flight profile and route based on the aircraft type and gross weight and the air temperature, wind velocity, and other factors. Unlike the present system, in which only geographical coordinates are calculated for aircrafts' future positions, AERA will forecast both coordinates and altitude, giving a three-dimensional position. In situations of potential conflict, AERA will identify an optimal corrective action and transmit instructions to the aircraft. The savings will include millions of gallons of fuel and many hours of flying time per year.

Such a system implies that the entire task of routing air traffic will be done with minimal human intervention, changing the controller's role from that of an active participant to that of a monitor. Only if the computer system shut down or judgments beyond the programmed instructions were required would direct human intervention be expected.

Meanwhile, late last year the FAA made a decision that will increase the responsibility of pilots. The FAA suggests that by 1985 to 1986, aircraft will be equipped with a so-called threat collision-avoidance system (TCAS) that shows the presence, the direction, and separation of other aircraft and, in certain emergencies, provides instructions for corrective action. This is one step toward a decentralized system in which pilots participate with controllers in the process of staying on course and avoiding collisions. Thus, some responsibilities of today's controllers will be transferred to pilots in the short term and to computers in the long term.

The air-traffic controllers' walkout postponed action by the FAA by temporarily focusing attention on personnel rather than equipment problems. But the government's expanded bargaining power means it can now implement such options to increase automation more readily and is moving aggressively to do so.

Hoo-min D. Toong, an expert in the design and application of microprocessors, studied electrical engineering and computer science at M.I.T. (Ph.D. 1974) and is now a member of the faculty of the Sloan School of Management. **Amar Gupta** is a postdoctoral research associate in the Sloan School specializing in computer processing; he holds graduate degrees in management and computer science from M.I.T. The authors thank Meichun Hsu of the Sloan School for valuable suggestions and the staffs of the FAA Office of Systems Engineering Management and of the H.H. Aerospace Design Co. for their assistance.

Further Reading

Britting, K.R., A.B. Conanower, A. Gupta, M. Hsu, F. J. Marcus, J.F. Oiesen, and H.D. Toong, *A Technical Analysis of Rehosting the National Airspace System Software*. Report prepared for the U.S. Department of Transportation by H.H. Aerospace Design Co., Inc., Bedford, Mass., under contract DT-FA01-80-Y-10595, August 1981.

Clapp, D., J. Hagopian, and R. Rutledge, *Analysis of Expandibility and Modifiability of Computer Configuration Concepts for ATC*, vol. 1, no. 1, FAA-EM-79-22, November 1979.

Bayh, Birch, et al., *Report of the Senate Appropriations Committee's Subcommittee on Transportation*, October 1980.

Helms, J.L., *National Airspace Systems Plan*, Washington, D.C.: Federal Aviation Administration, December 1981.

Toong, H.D., A. Gupta, M. Hsu, D.H. Shepard, C.J. Smith, and J.F. Oiesen, *Rehosting the NAS Software*. Private report prepared for U.S. Department of Transportation, January 1981.

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Thai

A Flight of Graciousness.


Reworking
Working
Closer
to
Home

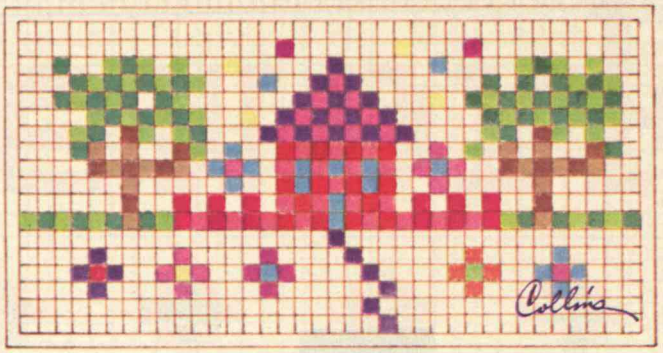
Telework may soon make daily long-distance commutes obsolete while enhancing worker productivity and satisfaction.

by Jack Nilles

THE Great American Dream is to live in a suburban setting at some little distance from the neighbors. The automobile provided this option and cities changed as a consequence. Today microelectronics technology is beginning to do the same for information workers. The microcomputer is the analog of the automobile: the telephone line and the communications satellite serve as the highways. The major difference is that information is transported rather than information workers, who then have the potential to become "telecommuters." In principle, the telecommuter has access to anyone with a computer—with near-zero transit time.

Teleworking is associated with significant increases in productivity.

Cloning the Home Office



While telework—the use of computers as a primary communications tool in the workplace—can be conducted from a centralized location just as easily as from a decentralized one, telecommuting implies decentralization. In effective telecommuting, if the information worker commutes at all, it is to the corporate office nearest his or her home. The organization essentially clones itself, locating regional work centers near the principal concentrations of its workers' residences. The regional centers are interconnected so that all accountants, marketers, salespeople, data entry clerks, and managers can communicate regardless of their individual locations.

No Commute Is A Good Commute

The significant changes in work style made possible by telework, particularly telecommuting, are substantial. One of the major benefits is, of course, time saved by avoiding a daily commute that today averages about 18 miles per round trip. If, as is likely, the worker commutes to a place much closer to home, the savings are less—even zero if the worker chooses to walk or bicycle to work instead of driving, but this alternative to hours tensed over a steering wheel may well be considered a benefit.

The result is direct as well as indirect monetary rewards for telecommuting employees. The most obvious is the possibility of eliminating the automobile from the household inventory, or of having the old one last a few years more because of reduced wear and tear, accompanied by smaller fuel and repair bills.

The information worker who works at home, or who personally provides the microcomputer for teleworking, may enjoy tax benefits as well. The cost of the equipment and computer programs, or software, are often deductible, as are house or apartment rental and maintenance expenses directly associated with the home office. The costs of an additional room and telephone for the telecommuter's office fit that criterion, as would additional insurance costs for any electronic gadgetry.

Housing itself is a growing problem, the central element of which is the high price of urban land. The location independence of telecommuting allows information workers to seriously consider relocating to small towns and cheaper real estate while retaining city jobs.

The Employers' Payoff

The primary concern of many employers considering the telecommuting option for their information workers is its effect on productivity. Although productivity is much more difficult to define when assessing information work than when accounting for the manufacture of products, it can be measured for support-level staff such as typists and data entry clerks. Our research indicates that teleworking is associated with significant (15 percent or more) increases in productivity in these areas. For management and professional workers the situation is more complex, since their work is less easily quantified and, until very recently, many of the tools of telework were not tailored to higher-level work environments. Microcomputers and manager/professional-oriented software may eventually improve the office productivity of many of these workers, but anecdotal evidence indicates that telecommuting has already improved the productivity of programmers, scientists, and others whose jobs tend not to be highly dependent on face-to-face contact with colleagues. (*See "The Office of the Future: Information Management for the New Age" by Paul A. Strassman, December/January 1980, page 54.*)

Although information technology directly aids productivity, more subtle factors are also at play. For example, some telecommuting professionals say they feel a greater responsibility toward their jobs, and that they tend to be more diligent when given the privilege of working at home. These workers range from computer programmers to middle-level and upper-level executives. However, no extensive studies have yet been performed to test this and other conjectures. Teleworking is still too new, and because it triggers organizational change and deviations from traditional forms of management, few executives are eager to be the first to give it a try.

An even more urgent concern than productivity for some employers is that of worker availability. General unemployment figures notwithstanding, there are

Because teleworking triggers organizational change, few executives are eager to be the first to give it a try.

chronic shortages of some types of skilled information workers such as secretaries and computer programmers. Some workers, such as parents of school-age children and the physically handicapped, are unable to commute long distances or are available only part time. By moving the job to these workers via telecommuting, the employer is freed from geographical restrictions in attracting competent and productive workers.

Operating costs in the central business district of a major metropolitan area are high. Rent or building ownership and other costs associated with attracting employees to these locations can constitute a substantial portion of corporate overhead, an expense telecommuting can reduce. Teleworking moves workers to lower-priced suburban properties—or even their own homes—at no additional cost to the employer, and can reduce office space per worker through office sharing by part-time telecommuters. In our 1973 study of a Los Angeles insurance company, we found that this factor alone (including the income from lease of the vacated downtown facilities) compensated for the costs of decentralization.

The Loneliness of the Long-Distance Employee

As with most technologies, there can be undesirable side effects to the benefits of teleworking and telecommuting. Most experiments in telecommuting now being conducted by U.S. corporations involve secretarial and clerical employees working from their homes. These workers frequently complain of isolation from their fellows. This is another reason for stressing the local work center, as opposed to working at home, as the best mode of telecommuting—it is unreasonable to expect the average information worker to forego all on-the-job social contact. An attractive compromise may be to encourage the worker to spend several days per week at home and a day or more at the local or central office to reaffirm collegial ties. Since the work product—information—is computer based, the daily location of the worker—the home or office—may not be a major factor in efficiency.

Many people are intimidated by the apparent inscrutability of computers. This situation is changing as young information workers, who have grown up with TV and pocket calculators, enter the labor force and reach management and professional levels. By the end of this decade, a large percentage of the labor force will own personal computers, further diminishing the intimidation problem. And with increasing machine sophistication and greater attention to the design of computer software, computer-naive workers can deal more effectively and comfortably with computers at reasonable cost.

Nonetheless, information workers who are not computer literate will be at a disadvantage if telework and other manifestations of the new information technologies become more widespread. The pace of displacement of these workers, though fairly slow, is accelerating, as is the rate at which these technologies are insinuating their way into the upper reaches of the corporate hierarchy. If there are no compensating expansions of the information market, telework-caused increases in productivity may result in unemployment.

One Input Too Many

Another potential problem of telework is that it can become compulsive and may exacerbate workaholism. The terminal or microcomputer in the den or living room may tempt the manager or professional to try "just one more" variation on that quarterly forecast. The convenience of the personal computer may also result in excessive polishing of the information product, polishing that previously was impossible or too inconvenient to bother with. In our surveys of personal computer owners, we found several who refused to take their machines home because they wanted to clearly separate their home and business lives. Telecommuting, in particular, can make that separation more difficult even while making work hours more flexible.

Out of Sight, Out of Line?

Foremost among issues that nag supervisors is that of control. A supervisor will ask, "How can I tell whether my employees are working if I can't even see them?" My usual rejoinder is, "How can you tell they're working when you *can* see them?" Except for routine secretarial and clerical work, where information results can be monitored almost continuously, supervision depends more on appearance than substance until the product appears. Here, too, the local work center provides an answer. Physical supervision of workers can be performed by anyone at the local center, and the quality of the information product can be checked by the functional supervisor, who may be located anywhere in the corporate telecommunications network.

Telecommuting allows information workers to seriously consider relocating to small towns and cheaper real estate while retaining city jobs.

Organizing Teleworkers

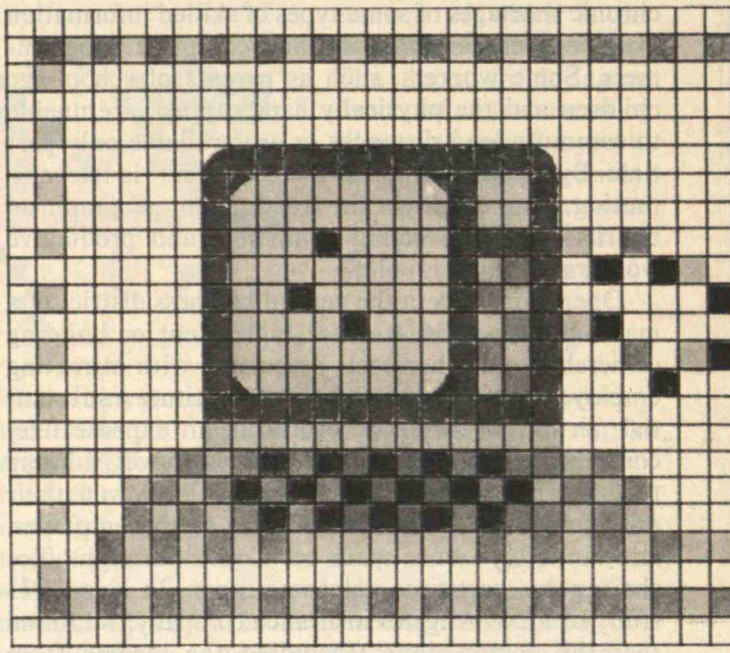
Human organizations often have concerns that have nothing to do with efficiency or bottom lines. For example, concern with prestige can transcend other, more quantitative considerations. The corporate image, particularly as embodied in a building crowned with the corporate logo in the central business district, is not to be trifled with. While decentralization via teleworking has its attractions, the potential loss of the downtown corporate edifice may in some cases prove more important.

Another image-oriented issue is the replacement of the personal secretary by the typing pool and, more recently, the word-processing center. During this process the discovery was made that secretaries can do a lot more than take dictation and type letters—some erstwhile secretarial jobs have evolved into entry-level managerial positions. Meanwhile, managers and, to a lesser extent, professional workers are sometimes reluctant to be seen actually touching a computer keyboard, an act they consider damaging to their professional image. Nevertheless, managers are learning to do their own "typing" with the use of effective text-processing software in their personal computers. Office sharing may also threaten some workers' conception of status. Teleworking is likely to continue to erode many traditional worker distinctions.

A less obvious issue, but one that ultimately may be of greater importance, especially in Japan, is that of employee loyalty and the feeling of corporate identity. In an organization with a central location to which most employees report, workers may be more likely to identify their personal goals with those of the organization. Are telecommuting employees less likely to be loyal to the company than those in the central location? Are home telecommuters more likely to be, or become, entrepreneurs selling their particular information services to the highest bidder? Will they be less enthusiastic or, more importantly, less productive in support of company goals?

The local work center may be a sufficient surrogate for the central office in developing company spirit. However, employees are also more likely to come in daily contact with employees from other organizations and compare notes on employee benefits, working conditions, and the like. For organizations with deficiencies in these areas, telecommuting could have threatening effects.

Coupled with this could be the expansion of the

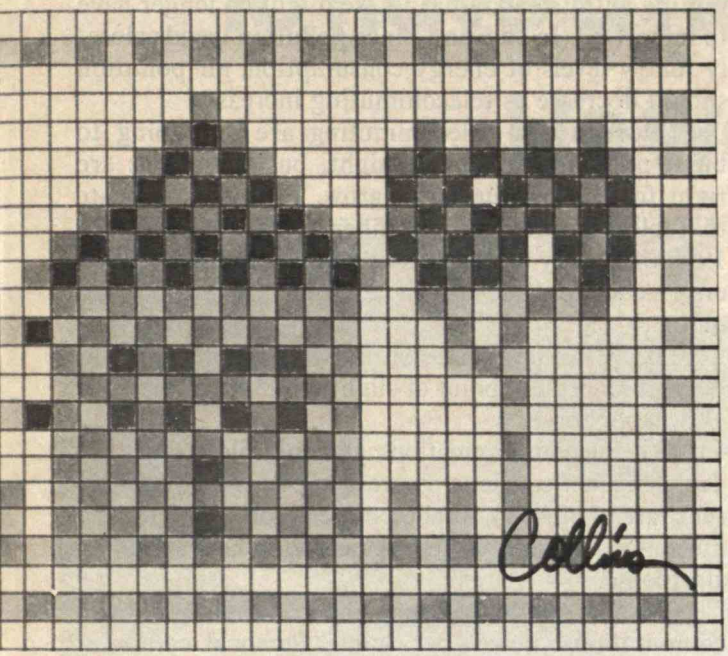


movement by information workers to form a union. Directors of information-intensive companies in the United States tend to be uncomfortable with the idea of unionization, and they also believe that decentralized organizations are more likely to become unionized than centralized ones. While there is little evidence for this, the feeling persists.

Historically, the influence of unions among information workers has been small. However, this influence is growing among clerical workers and professionals such as engineers and scientists. Unions may gain support and improve benefits for information workers through the advocacy of telecommmuting, provided that as the technologies are introduced in an organization, union members are adequately trained to use them. In the near term, however, unions are likely to be ambivalent about telecommuting, primarily because few have considered the process at all—they see neither great threats nor great opportunities in the process. Union officials we have talked with generally say that telecommuters could be covered through minor modifications to existing contracts. While telecommuting may be an attractive issue in unionizing centralized organizations—"Join the Union and Work Near Home"—the impediments to organizing already telecommuting-dispersed companies may be substantial.

Nevertheless, telecommuting may well provoke union-associated issues. Foremost among these is the apprehension about a return to the "sweat-shop"

Some managers and professional workers are reluctant to be seen actually touching a computer keyboard.



atmosphere through piecework payment systems, forcing some production costs onto workers, and the absence of enforced periodic rest breaks—people hunched over computer terminals for several hours need a break. Most of these issues are significant only for home telecommuters; it's unlikely that workers in dispersed centers would encounter them any more frequently than employees in traditional office settings.

A final impediment to the telework concept is tradition. People have been accustomed to leaving their homes to go to work ever since the early days of the Industrial Revolution. Cottage industries were supplanted by more efficient means of production that required workers to go to central locations to operate the machines. For information workers, that rationale is steadily becoming less compelling, but the pattern is set nonetheless.

The International Network: Drawing the Line

Telecommuting makes possible a job migration without transportation. When the unavailability of low-cost transportation, the lack of local job opportunities, and the high levels of functional illiteracy make the escape from poverty or dependent living seem impossible, as in many urban areas, low-cost computers and software can provide entry-level information jobs. The critical point is that the inherent power of computer-based instructional techniques must be used to train these workers to at least a minimal level. Neither the software nor the private-sector or public-sector programs exist today to facilitate this transformation, yet the basic concepts and the technology do exist.

However, communication satellites make it possible to export jobs to other countries as well as to Appalachia. Thus, we as a nation are confronted with an interesting dilemma: do we use telecommuting to aid those who otherwise have no access to economic success, or do we use it to improve the economies of other nations? The technology has already escaped Pandora's box—if we don't use it, others will. The exported jobs may include not only those of entry-level information workers but of higher-level employees as well. The net result could be an influx of job opportunities in the U.S., if we capitalize on our unique expertise in many aspects of the information industry to satisfy demand in other countries.

Futuristic Scenarios

Widespread telecommuting can have major long-term effects on our national landscape. There are at least two possible types of change. The first consists of surrounding the local office complex with residential areas. This would result in the development of numerous city clusters, each with a population of from 100,000 to 200,000 (a good size for efficient provision of services such as law enforcement and street repair). The average commute to work in such a citylet would be three miles or less. Citylets would be interconnected by telecommunications networks and, of course, freeways for efficient, non-peak-hour automobile and truck travel.

Since the theoretical locational freedom made possible by telecommuting is limitless, a telecommuting society could scatter its dwellings more or less uniformly between its boundaries. But this would leave the remnants of city centers to blue-collar and other workers unable to telecommute, and would also require inefficient and energy-expensive systems for distributing materials and supplies to the "urban" population.

Both these extremes imply significant changes in existing central business districts. If many organizations were to flee the urban business district in favor of dispersed operations in the suburbs, blighted central-city areas could become still worse. One alternative might be to convert city buildings into multi-use facilities, bringing residences back to what are now office-only city cores. In a reversal of the usual

With increasing machine sophistication, computer-naive workers can deal more effectively and comfortably with computers at reasonable cost.

concept, workers might live in the city center and telecommute into the suburbs.

A Watt Saved Is a Watt Earned

Information workers make good energy conservers. Neither the use nor the production of computers and telecommunications is energy intensive. A typical computer terminal uses about 100 watts of power, and a microcomputer with a relatively massive memory might use an additional 200 watts. In most cases, this energy cost would be incurred anyway as individuals in an organization acquire their own computers; the added energy cost of telecommunications is on the order of a few watts.

Transportation is energy intensive, accounting for about one-fourth of total national energy consumption. About one-ninth of this consumption is due to the urban automobile, which uses about 3 kilowatt-hours of energy for each passenger-mile traveled. For every 1 percent replacement of urban commuting by telecommuting, the national gasoline bill would be reduced by 5.4 million barrels per year. In other words, if we replaced one-seventh of our urban commuting with telecommuting, we might no longer have to import oil. In addition, since pollution trends closely follow levels of energy consumption, air pollution should decrease as telecommuting increases.

Telework and telecommuting are not going to burst upon the scene overnight, but conditions are right for their influence to grow. Estimates indicate that telecommuters now number in the thousands. By 1990 there may be as many as 10 million telecommuters (mostly part-timers) if additional conditions are met:

☐ The information sector must continue to grow beyond its present point of slightly more than half the U.S. labor force.

☐ The telecommunications and microlectronics industries must continue to grow in power at their current rate of close to 30 percent per year, and telecommuting software must be made widely available and affordable.

☐ Personal computers must also continue to grow in computational power per dollar. Personal computer software provides capabilities, including "friendliness," generally not available on mainframe (large industrial) computers.

☐ Energy shortages may prove to be one of the greatest incentives, causing employers and employees alike to reconsider the high costs of commuting. An energy shortage sufficient to induce gasoline rationing would greatly increase telecommuting.

Telework and telecommuting are likely to increase at an accelerating pace over the next decade, spurred by many independent societal trends. This technology provides more options to both employers and employees, but the resulting changes, though sometimes subtle, can be ubiquitous, taking years before their effects are widely recognized. The costs and benefits of this rapidly disseminating technology must be defined and evaluated before any major and irreversible changes in the way society does business are implemented.

Jack M. Nilles is senior research associate in the Center for Futures Research at the University of Southern California at Los Angeles. He is coauthor of *The Telecommunications-Transportation Trade-Off* (John Wiley and Sons, 1976).

Further Reading

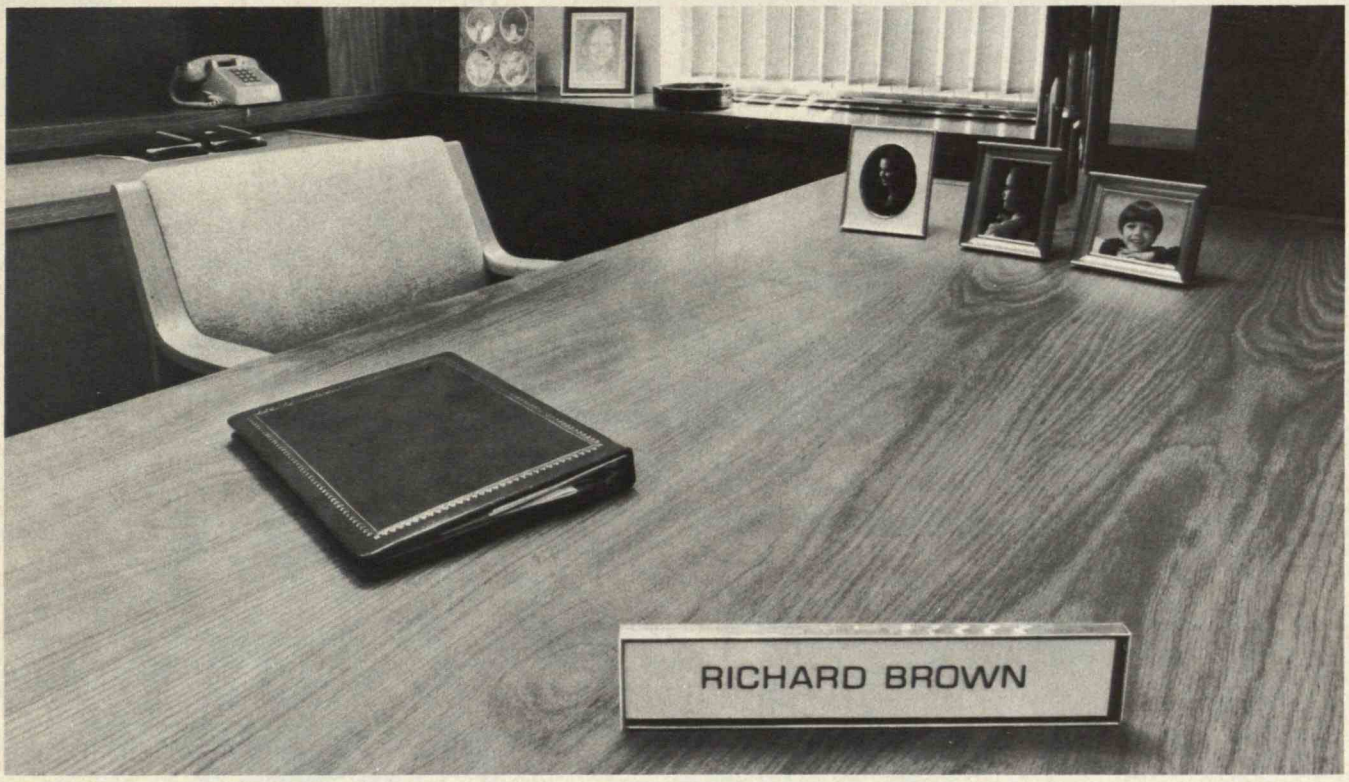
Hiltz, Starr Roxanne, and Murray Turoff, *The Network Nation: Human Communication via Computer*. Reading, Mass.: Addison-Wesley, 1978.

Hirst, Eric, *Energy Intensiveness of Passenger and Freight Transport Modes, 1950-1970*. Oak Ridge National Laboratory, April 1973.

Porat, Marc Uri. *The Information Economy: Definition and Measurement*. U.S. Department of Commerce, Office of Telecommunications, Special Publication 77-12, 1977.

Richard Brown thought he was too young to have a heart attack.

He wasn't.



Because having a family, a good job and a bright future doesn't protect anyone from heart attack. In fact, nearly one million Americans — many with those assets — die of heart disease and stroke each year. And 200,000 of them die "too young."

The American Heart Association is fighting to reduce early death and disability from heart disease and stroke with research, professional and public education, and community service programs.

But more needs to be done.

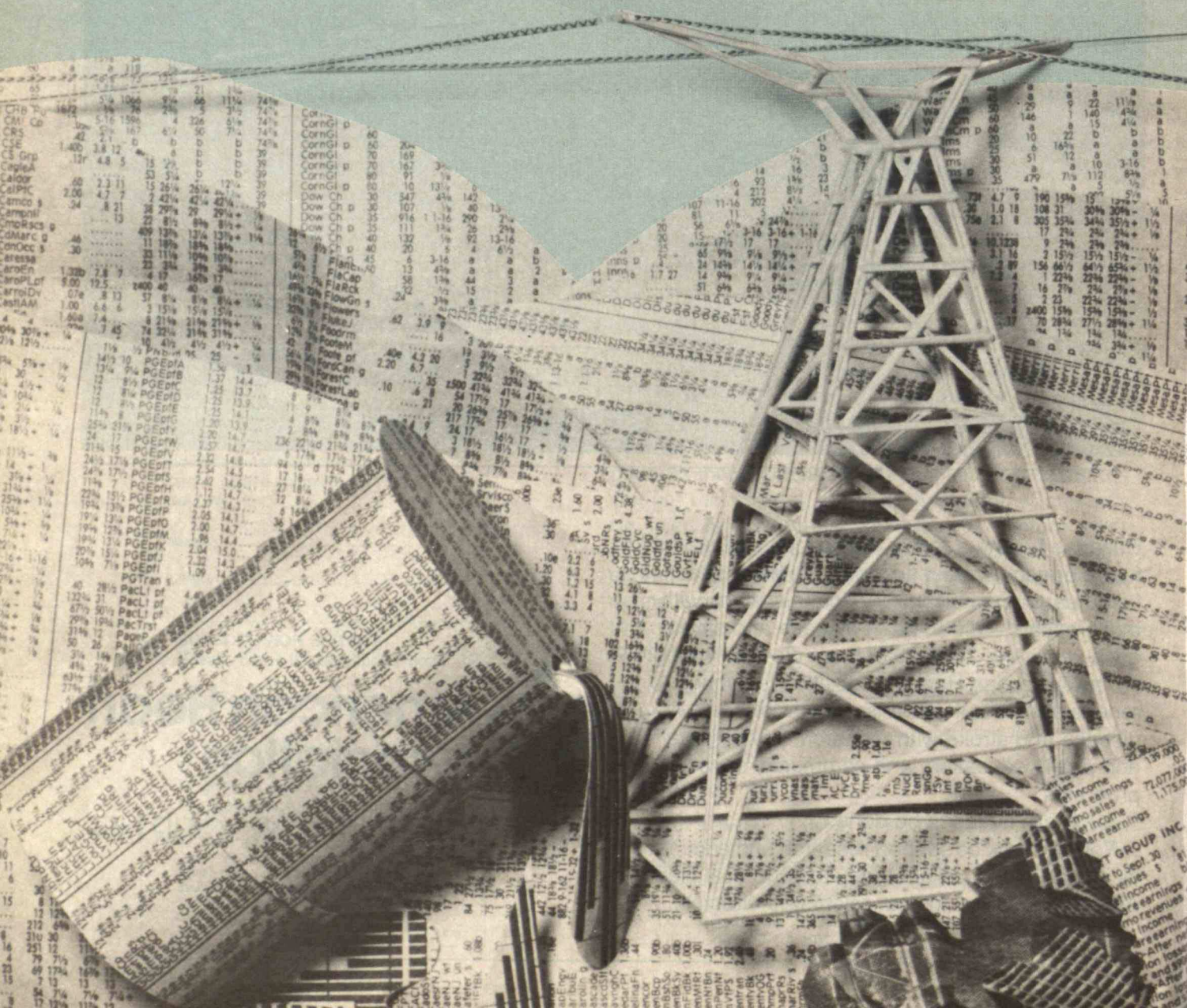
You can help us support research and education by sending your dollars today to your local Heart Association, listed in your telephone directory.

American Heart Association

WE'RE FIGHTING FOR YOUR LIFE

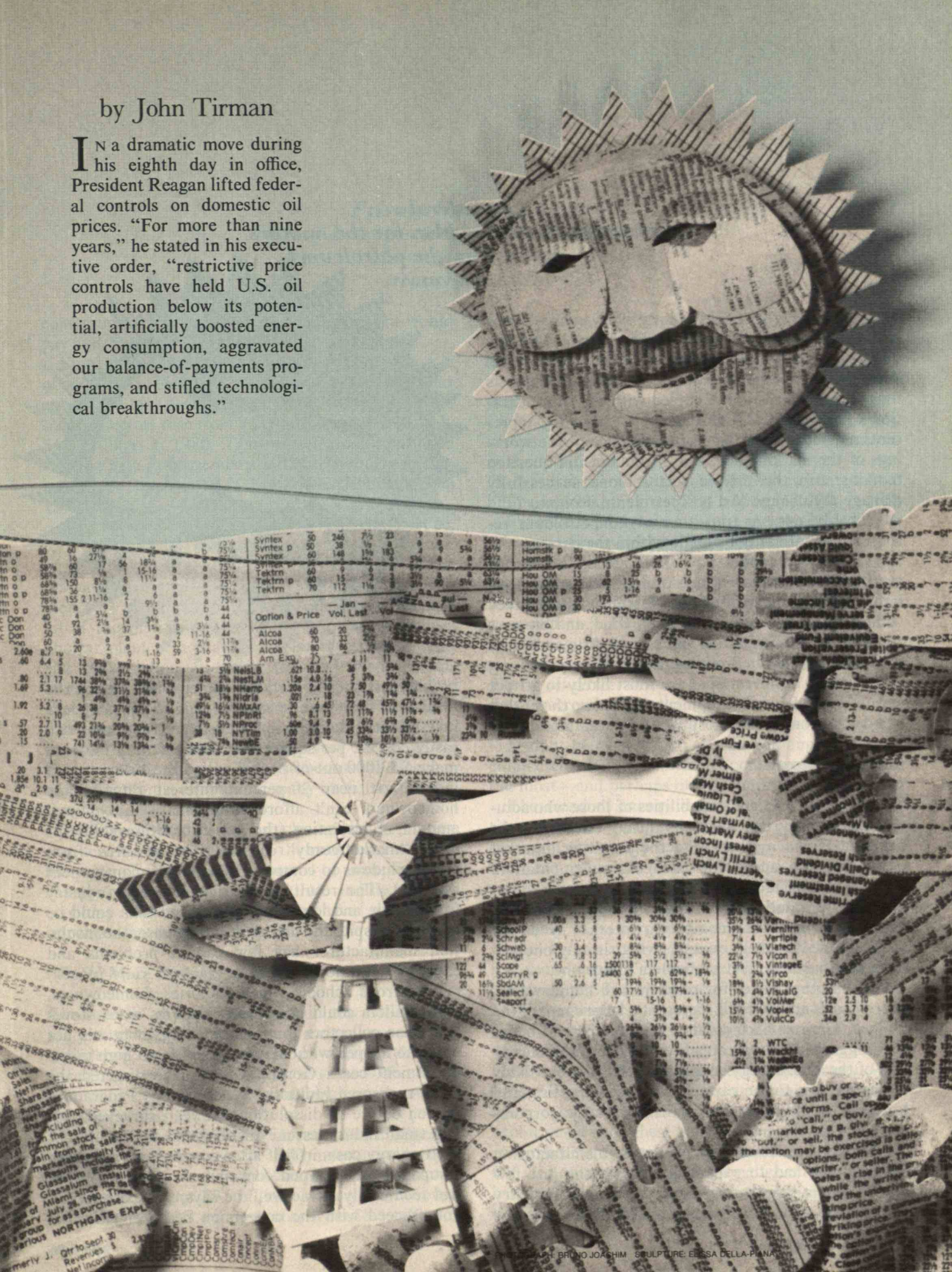
Investing in the Energy Transition: From Oil to What?

By trying to create a "free market" for energy, the federal government may well impede the development of alternatives.



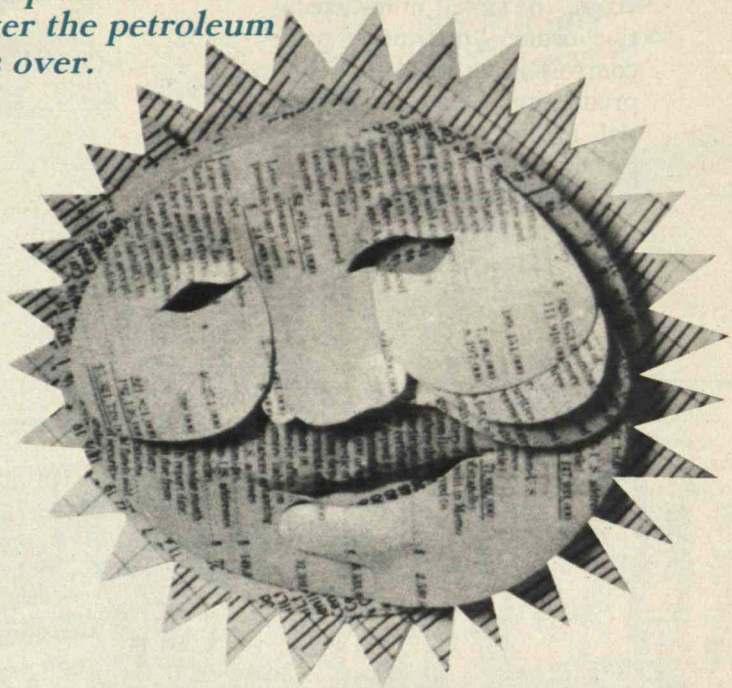
by John Tirman

IN a dramatic move during his eighth day in office, President Reagan lifted federal controls on domestic oil prices. "For more than nine years," he stated in his executive order, "restrictive price controls have held U.S. oil production below its potential, artificially boosted energy consumption, aggravated our balance-of-payments programs, and stifled technological breakthroughs."



PHOTOGRAPH: BRUNO JOACHIM SCULPTURE: ELISSA DELLA-PIANA

The federal government has yet to plan for the nation's energy needs after the petroleum era is over.



In the last eight years virtually every energy study has recommended an end to price controls and the distortions such a policy creates in the marketplace. Though the method of decontrol is hotly debated, its long-term effect is not. Coupled with the administration's budget actions, this new energy policy represents an unequivocal vote of confidence in the workings of the marketplace. But a fundamental question remains: can the private sector alone successfully manage the change to a postpetroleum economy?

Probably not. A transition to nonpetroleum resources cannot easily be made within the current pattern of private capital flow. Left alone, the energy marketplace encourages investment in the most profitable short-term strategies. Nascent "alternative" technologies such as solar heating, wind, and biomass (as well as the embattled nuclear electric industry) are measured by the profit yardstick: those promising quick return on investment are most likely to attract private capital for development and sales; those that lack such promise are most apt to go wanting.

Insulating Demand

The varying needs and capabilities of those who actually *use* energy can have significant effects on the nucleation of a market—and the resulting "market pull" that can speed the pace of implementation. Businesses considering new, energy-efficient equipment range widely in their ability to raise the needed capital, and each has competing internal needs for such capital. After all, energy savings is only one priority of a business, and probably a minor one.

On the other hand, for retailers and homeowners, energy costs are likely to represent a large share of the budget. Their small individual energy demand belies their aggregate energy appetite: they consume nearly half of the U.S. energy supply. But they are not likely to have access to the capital, in-house expertise, and tax benefits and incentives available to large corporations.

Consider insulation. The insulation-manufacturing industry has had to expand greatly in the last few years to meet burgeoning market demands. Industry giants such as Owens-Corning are likely to have few problems raising capital, but homeowners buying the insulation may require costly loans to finance their investment. Insulating a 1,500-square-foot home can easily cost $2 per square foot, and a family that can make a $3,000 out-of-pocket outlay these days is rare indeed. At near 20-percent interest rates, many homeowners can't afford to purchase the optimal amount of insulation (the same condition holds for other "market-ready" conservation measures, from storm windows to computerized energy-management systems). The result: lower demand than industry would wish, and less oil and gas saved than could be possible, despite the fact that, in this case, the insulation manufacturer has few capital problems and capacity limitations.

Numerous schools, small factories, homeowners, and retailers could use devices such as wood stoves and solar collectors to produce energy, but it's not about to happen without some relief from high initial investment costs. Gordon Deane, who directed the DOE-sponsored Industrial Wood Energy Program in Boston before its dissolution last year, surveyed over 100 small industries in New England that could cut their energy costs in half after conversion. "Of those companies where wood conversion was economically and technically attractive," he says, "51 percent did not proceed with the conversion because of capital

Private financing alone cannot be expected to launch and support the nation's energy transformation.

constraints. This, even though the investment would pay a 30-percent [annual] rate of return."

Similar up-front financing hurdles plague the sale of active solar heating systems. Despite their popular appeal and long-term financial attractiveness, sales of solar collectors rose from $275 million in 1979 to only $400 million in 1980. That rate of growth is not in keeping with improvements in the technology, installation, and the cost of fuel oil, which doubled from 1978 to 1980.

"We have an investment crisis," says Henry Lee, former Massachusetts energy chief and now director of the Energy and Environmental Policy Center at Harvard University's Kennedy School of Government. "With interest rates high and oil prices flat, a lot of the momentum—whether it be in building a nuclear plant or a peat facility or investing in solar and conservation—is going to slow down. In this investment climate you're going to see a great deal of energy activity come to a grinding halt. The renewables industry is going to be in serious trouble. The financial barriers are becoming very large, partly because of interest rates but also because the Reagan administration is eliminating many investment incentives and federal support."

All investment has its obstacles and uncertainties, and new ventures always ride the roughest road. The financing of new energy options is no exception, but energy plays such a profound role in the nation's economy that such investments have particularly important national ramifications.

(Much) More Business as Usual

The level of capital investment in the U.S. energy sector over the last three years is a clear expression of confidence in current means of fueling the fire. Investments in the energy business since 1978 indicate increasing commitments to the future production of all types of fossil fuels:

☐ In 1979 the oil industry invested $44.2 billion in domestic oil operations, in 1980 investment jumped to $60.5 billion, and in 1981 capital spending in oil increased to about $75 billion. Meanwhile, overseas investment by U.S. oil firms rose from $8.3 billion to $16.7 billion. Total capital investment by oil companies (of which about 40 percent was borrowed) accounted for about 20 percent of *all* capital spending in the U.S. for plant and equipment during these years.

☐ The coal industry, much of which is owned by oil companies, also expanded and is currently capitalized at about $15 billion.

☐ Natural-gas utilities invested an estimated $6.0 billion in 1981, up from $4.4 billion in 1979.

Future capital demands on the energy sector will be awesome. From 1981 to 1990, oil and gas firms will need an additional 1.0 to 1.5 *trillion* dollars to maintain current levels of production; the electric utilities, which invested $64.2 billion in new equipment and construction in 1979, anticipate borrowing $750 million during this period. Such a large demand for capital may have serious repercussions on the economy. *The Wall Street Journal* warns that "the oil business's borrowing muscle, added to Uncle Sam's, may push some lighter-weight debtors right out of the U.S. debt market." Such speculation augurs a worsening credit squeeze in which booming oil firms are in the most—and perhaps only—comfortable position.

The trend of energy investment is toward gigantism, as evidenced by the recent merger phenomenon among major energy-related corporations. Such takeovers are rational moves for firms that stand to acquire known oil and coal reserves without expensive and risky exploration and leasing, but the takeovers are likely to be zero-sum games for the nation as a whole. In two recent dramatic scrambles, Du Pont last year bought Conoco, the ninth-largest U.S. oil company, and U.S. Steel acquired Marathon Oil Co. Mobil's willingness to pay $8.8 billion for Conoco and U.S. Steel's bid of $6.4 billion for Marathon (which itself dropped a $650-million offer for Calgary-based Husky Oil's U.S. holdings) astounded many Wall Street veterans, who wondered at the huge credit lines quickly made available. (Interestingly, on the day Mobil made its highest bid for Conoco—it also made an unsuccessful move to win Marathon—tiny Clark Oil Co. quietly purchased a smaller oil concern for half a billion dollars, causing hardly a ripple of attention.) Shell Oil recently purchased Bellridge Oil for

The U.S. energy sector has attracted large capital investment over the last three years—a clear expression of confidence in today's means of fueling the fire.

$3 billion and Exxon acquired Reliance Electric for $1 billion.

Handicapping the Capital Competition

There is another side to the energy investment coin that gleams even less brightly. Alternatives to oil and natural gas—from nuclear power to passive solar heating—will become increasingly important to the U.S. energy sector by the end of this century. But they are attracting only spotty and unenthusiastic investment. If this pattern persists, alternative energy technologies will be undercapitalized, underdeveloped, and unable to replace conventional fuels as quickly and as efficiently as they might.

The energy sources collectively called renewables—which include heating, photovoltaics, wind, biomass, cogeneration, and ocean-thermal energy conversion—could supply 20 percent or more of U.S. energy needs by 2000, with major increments thereafter, according to the Solar Energy Research Institute, the Council of Environmental Quality, the Harvard Business School, and the U.S. Office of Technology Assessment. But this estimate assumes vigorous support for renewables and conservation from Washington.

From the inception of Project Independence in 1974 until the Reagan administration, the official federal position was to help develop selected renewable technologies and to provide modest tax incentives to encourage their implementation. Under the current "marketplace strategy" of energy development, renewables of all kinds will receive much less federal support. But while private capital may well be attracted to renewable energy technologies when they are ready for market, capital is also required to *get* them there.

Federal support is not lacking for the development of nuclear power and synthetic fuels, despite strongly negative government assessments. For example, the administration's decision to proceed with the Clinch River breeder reactor flies in the face of a highly critical study from Brookhaven National Laboratory, which recently rated the breeder as the "least priority" among the "most valuable energy technologies, measured by their ability to reduce direct costs of oil imports" over the next 40 years. Brookhaven says that its findings are "generally consistent with those of others on the lack of a present need to complete the nuclear fuel cycle by building plutonium breeder reactors." The laboratory instead recommends that greater emphasis be placed on improving the performance of light-water reactors, on retrofitting conservation measures in buildings, and on developing industrial energy cogeneration, enhanced oil recovery, electric heat pumps, shale oil, and geothermal energy (the study is also negative on coal liquefaction).

In addition, the congressional Joint Economic Committee report, "Pursuing Energy Supply Options: Cost-Effective R&D Strategies," considered the future of breeders and fusion reactors too uncertain to be evaluated. Some of the committee's other determinations:

☐ Heavy oil and unconventional gas (gas that is reachable by deep drilling, subterranean explosions and other expensive techniques) appear to promise the highest returns for "limited" support.

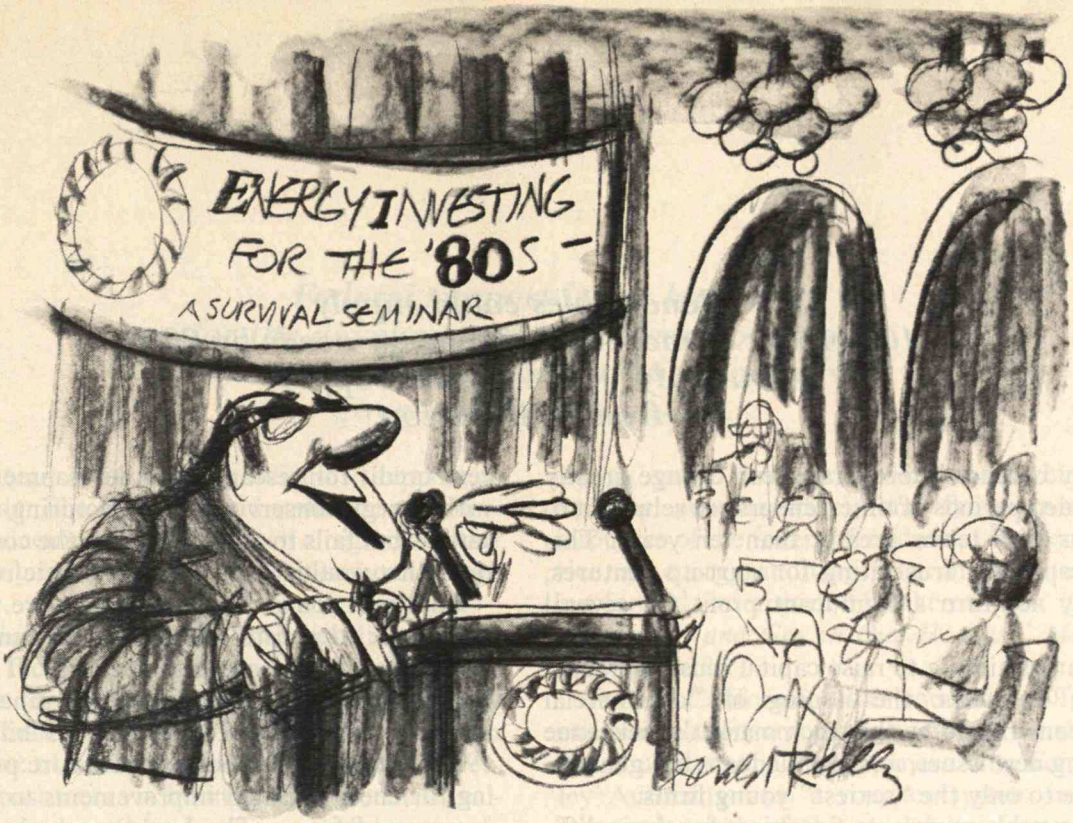
☐ Conversion of biomass to liquid fuels, solar heating and cooling, low-Btu coal gasification, and wind energy promise moderate results for limited support.

☐ More modest returns on investment are likely from photovoltaics, oil shale, fluidized beds, and process-heat recovery techniques.

☐ Two big losers ("extensive support/small returns") are high-Btu coal gasification and ocean thermal energy.

Federal subsidies for nuclear power totaled nearly $2.5 billion in 1981 and are expected to grow; similarly, huge federal outlays are planned for the development of the synthetic fuel industry. Combined, these two energy sources may produce about 14 quadrillion Btu's of energy annually by the year 2000—about a 15 percent share of U.S. energy supply—but by then their combined federal subsidy will have reached at least $200 billion.

The rationale behind such generous support is that private industry cannot develop these energy technologies because of the expense (or should not because of associated hazards, as with nuclear power). But such



"So here's what we're saying.
The sun, wonderful as it is, can't do it alone, but, combined with the magic of the marketplace, anything is possible."

Drawing by Donald Reilly; ©1981 The New Yorker Magazine, Inc.

reasoning tends to deflate rationalizations for replacing federal R&D support for renewables and other energy alternatives with a marketplace strategy.

Federal involvement is no guarantee of energy security or good management, and critics of federal aid to energy R&D point to the success of simple, privately developed conservation techniques: cogeneration, insulation, and industrial heat-recovery systems. The combined market for these technologies reached $8.3 billion in 1980 and will rise to $30 billion by 1985.

But because of dwindling federal support, the renewables, which will provide new supply, appear to be in a state of financial limbo. Consider photovoltaics, which the congressional Joint Economic Committee estimates to have the potential of generating 1 to 3 quadrillion Btu's of electrical energy annually by the year 2000.

The funding of photovoltaics R&D has been almost entirely a federal effort. Appropriations of over $500 million were made during the Carter years alone, compared with at most $150 million of private capital (most tied to government cost-sharing contracts), according to Solar Investors Co. of New York. Clearly, without sustained federal support, photovoltaics progress is likely to remain in the dark. Yet with continued support, photovoltaics could be commercially competitive in only a few years, yielding "competitive grid power by 1990," says the committee, with similar assessments from the American Physical Society, the Government Accounting Office, and the Office of Technology Assessment.

The financial outlook is similarly bleak for the 200 or so solar-heating equipment makers in the U.S., nearly all of which are small entrepreneurial businesses. If such businesses are to grow and others are to join them, they must be able to acquire development capital at reasonable rates. Barring federal largesse, access to private development funds is mitigated by several longstanding institutional barriers. Consider these observations made by Lynn Brown, an executive at the Federal Reserve Bank in Boston:

☐ Major credit institutions tend to favor companies with proven performance, an unachievable criterion in innovative fields such as solar energy technology.

☐ Small businesses typically need relatively small loans, but commercial banks prefer to make large loans to lessen overall transaction costs. For example, several years ago a large New York bank lent $2 billion to Sonatrach, an Algerian energy concern, to develop its natural-gas facilities. The bank's cost to write that single loan is far less than the cumulative costs of writing one thousand individual $2-million loans to small, entrepreneurial firms.

Renewables could supply 10 percent or more of U.S. energy needs by 2000, but only with vigorous support from Washington.

☐ Largely because interest rates can change greatly over extended periods of time, lenders are reluctant to make loans with terms greater than ten years. This policy is especially frustrating for start-up ventures, which may not turn a significant profit for several years.

☐ Companies aiming to raise capital must overcome forbidding obstacles: the issuing of "commercial paper" is constrained by the stock market's resistance to accepting new issues, and sizable loans are generally available to only the "sexiest" young firms.

One cannot blame private financiers for these difficulties: they have responsibilities to their depositors and stockholders. But it is obvious that such conventional business practice is ill-suited to mold the nation's future energy sector.

What Government Can Do

Fiscal policy tools available to federal, state, and local governments can encourage energy conservation to cure the nation's oil habit—and without draining the public treasury. Many of these tools have proven results; others are more speculative. A selection:

Tax credits. Tax writeoffs stimulate investment. The Energy Act of 1978, as amended (it expires in 1985), led to claims in 1979 for $435 million in residential conservation credit and about $200 million in industry credits. The act provides for a one-time 15 percent tax credit for expenditures for residential energy conservation—up to 40 percent for renewable energy devices in homes and 10 percent in businesses, but only for investments in process-related energy technology. The act would be much more effective if it granted credits for *all* energy-saving installations, if it made the credits more generous, and if it allowed energy-conservation investments to be amortized over five years or longer.

Tax credits of 50 percent or more would stimulate donations to energy-related projects conducted by nonprofit research institutions such as universities. Special tax credits could be granted to businesses or trade groups undertaking basic energy research and development programs with potential for wide application. (The 1981 tax bill does provide for a 25 percent credit for research and development connected with energy-conserving, manufacturing-related innovations but fails to grant credit for the costs of innovations that would simply conserve basic resources.)

Consumer loans. Two attempts were made during the Carter administration to ease consumer financing of equipment that could save energy. The Solar and Conservation Bank (Title V of the Energy Security Act) was authorized to loan $3.025 billion through 1983, and could also be used to secure private financing for energy-related improvements to homes, businesses, and farms. The bank was budgeted at $125 million for 1981, and its "parent" agency (the Department of Housing and Urban Development) issued preliminary regulations just before President Reagan took office, but its future is uncertain.

The National Consumer Cooperative Bank, established in 1979 (by a one-vote margin in the House), was intended mainly to aid food co-ops, but under its terms energy co-ops are also eligible for low-interest loans. This new institution, which was marked for dissolution by the current administration, has just become a private institution.

State corporations. Despite widespread fiscal difficulties, many state governments are supporting energy development projects. Connecticut's Project Development Corporation and Development Authority underwrites energy-related projects by issuing bonds. The New York Energy Research and Development Authority supports various energy-related activities much like a private bank. Oregon's state constitution was recently amended to enable the state to develop an aggressive solar loan program. California's new State Assistance Fund for Energy, Business, and Industrial Development Corporation (SAFE BIDCO) has a $2.5-million line of credit from the state with which to "leverage" additional alternative-energy loan guarantees from the federal Small Business Administration (for a total loan pool of $25 million) and private lenders. The state encourages muncipalities to issue bonds to support the development of renewable energy sources and the retrofitting of public buildings with energy-conserving devices and materials.

Regional programs. Groups of states can focus on

Federal support is not lacking for the development of nuclear power and synthetic fuels, despite strongly negative government assessments.

regional concerns that could be difficult to support on a federal scale. The New England states are considering making a compact, perhaps even a regional power authority, to buy power from Hydro-Quebec through a bond issue.

Utility financing. Private and public utilities throughout the United States are writing loans to homeowners for the purchase of energy-conserving devices and materials. Utility financing has a number of advantages: utilities already have financial connections with consumers via billings; they can easily calculate fuel savings; they have a vested interest in reducing the growth in energy demand (assuming the energy saved through conservation is cheaper than building new capacity); and they can utilize the resources of the federal Residential Conservation Service, an energy auditing program initiated by DOE but funded and operated by the utilities. (*See "Drilling for Oil and Gas in Our Houses," March/April 1980, page 24.*)

Several California power companies offer no-interest loans to consumers financed by a small surcharge distributed among all customers. The Tennessee Valley Authority uses a voucher system in which the marginal worth of the electricity a consumer saves over previous similar billing periods is split between

Without sustained federal support, photovoltaics is likely to remain in the dark; with continued support, it could be commercially competitive in only a few years.

that consumer and all other TVA customers. Arkansas Power & Light Co. offers home energy audits, finances recommended measures with interest-free loans, and collects loan payments through monthly electric bills.

The convenience and mutual interests served by such programs could well accelerate the introduction of simple renewable technologies such as solar hot water heaters. However, before that can happen, utilities must be convinced that such loan programs can postpone the need for capacity expansion, improve their cash flow, and reduce fluctuations in demand.

Pension funds. The total value of all pension funds in the U.S. is roughly $500 billion. The sheer magnitude of that figure should attract the attention of states and municipalities that wish to develop energy options without resorting to new taxation or shifting established budget resources. The use of such funds to support energy-saving programs has a precedent: pension funds traditionally have been used for home mortgages, and this practice could be extended to support the cost of improving the energy efficiency of homes. Ultimately, the long-term promise of energy investments—particularly in labor-intensive alternative technologies—may well prove decisive in spurring the utilization of this vast capital resource.

Both public and private pension funds permit some employee control. Unions in particular have moderate influence over private pension funds, most of which are invested in corporate securities. Public employee pension funds (which account for about half of the $500-billion total) could be funneled into "socially responsible" public development corporations, state and community development funds, or even state-owned banks (as in North Dakota).

Building codes that emphasize energy efficiency. Homes and businesses (excluding transportation) together consume about 39 percent of the nation's fuel, generally for space heating and cooling. There are several disincentives to making improvements, mainly the rising cost of new construction. Builders want to keep already high capital costs—and prices—down. They are therefore generally reluctant to utilize costly and often unproven energy-saving designs and equipment, which are usually not covered by local building codes and union contracts. Thus, energy efficiency is frequently sacrificed even when the lifecycle benefits are favorable.

The Department of Energy attempted to mandate new building efficiency performance standards (BEPS) as part of the Energy Conservation and Production Act of 1975, but withdrew these regulations last 1980 after a hail of protest from the building trades. The Reagan administration has indicated its firm opposition to BEPS.

Landlords of the 23 million rental households in the U.S. have little incentive to retrofit their buildings (most commercial space is leased as well). Few federal energy tax credits are available to sweeten such investments, and it is standard practice to pass along fuel costs to tenants. In today's tight rental market, there is virtually no reason for building owners to invest in energy efficiency of any kind. However, states and municipalities could cut back energy waste by enacting their own building efficiency regulations. Some cities, including Minneapolis, already mandate a modest level of investment in energy conservation measures for rental housing at the time of ownership transfer.

Energy R & D in a Postpetroleum Era

The federal government has so far failed to plan for the nation's energy needs after the economics of petroleum use become so adverse that new energy sources must be utilized. Such long-range thinking about the research, development, and deployment of replacement technologies appears ever more remote in the current climate of "free-market" problem solving.

Private financing alone cannot be expected to launch an integrated energy transformation. The public and private sectors must work together to forge a far-reaching national energy policy that is rich in innovative approaches to financing new technology.

John Tirman holds a Ph.D. in political science from Boston University. He has been senior energy policy analyst for the New England Regional Commission and an energy reporter for *Time*, and is now a free-lance writer and consultant.

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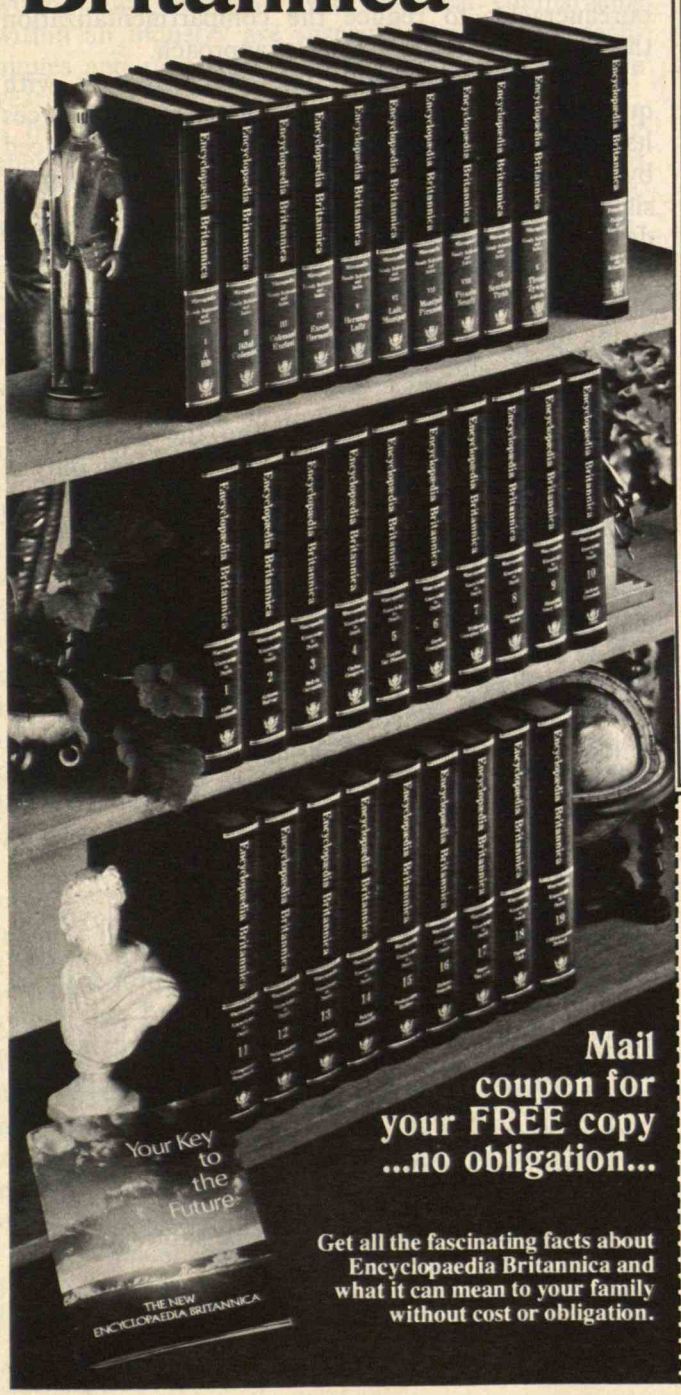

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LITHO IN U.S.A.

Environmental controls produce their own environmental impacts, and piecemeal approaches may simply reshuffle the damages.

Energy Hazards: What to Measure

(*Continued from page 38*)
degrees of hazard control than would have been the case if the desired environmental characteristics had been designed into the technology in the first place.

Present understanding of energy-related environmental hazards is sufficient to permit far better integration of environmental criteria into the engineering of new energy options. Fusion, direct harnessing of sunlight, energy from biomass, and increased efficiency of energy end-use each represent a diverse array of technological possibilities, and it is essential to emphasize development of the most environmentally attractive options. But the opportunity could slip away if the myopic view of the energy problem as a simple matter of expanding supply, regardless of environmental and social costs, continues to prevail in the Reagan administration.

Toward Equity and Efficiency

Which energy-related environmental issues will command the attention of analysts and decision makers in the eighties? Here are some contenders.

Interactions among environmental controls. Attempts to control the environmental hazards of energy sources have evolved piecemeal, typically focusing on one energy source at a time, one environmental medium at a time, and one type of damage at a time. But environmental controls produce their own environmental impacts, and such piecemeal approaches often simply reshuffle the damages. For example, environmental controls may displace the burdens:

☐ From one location to another, as tall stacks shift sulfur-oxide emissions from near a power plant to farther away.

☐ From one medium to another, as stack-gas scrubbers alleviate air pollution by concentrating the troublesome elements in water-polluting and soil-polluting sludge.

☐ From one fuel-cycle step to another, as solvent refining or liquefaction of coal shifts environmental burdens from the combustion stage to precombustion processing.

☐ From one type of damage to another, as when occupational radiation exposure increases when nuclear fuels are processed in ways that make them less vulnerable to misuse in weapons.

☐ From one energy source to another, as increasingly stringent controls on coal encourage the use of nuclear fission, or vice versa.

Evaluation of a control measure therefore must encompass not only the direct economic costs and intended environmental benefits but also the unintended displacement of environmental damages. Such an integrated assessment will stretch the capabilities of environmental science and environmental economics. Incorporating the results into policy almost certainly will require the restructuring of regulatory bureaucracies to reduce the compartmentalization that now inhibits an integrated approach.

Occupational hazards. The preoccupation with quantifiable hazards in comparisons of energy sources has led to heavy emphasis on the hazards experienced by workers in energy-related industries. This emphasis has expanded from traditional concerns with accidents and diseases afflicting coal and uranium miners to include accidents and diseases in the industries that manufacture energy-conversion equipment, and even in the industries that produce materials such as metals, cement, and plastics used to construct energy facilities.

The relative ease of calculating the numbers of worker deaths and injuries per unit of energy output will no doubt encourage continued emphasis of these hazards by energy-assessment analysts. But there are several reasons for questioning what these numbers really tell us. A high figure for occupational hazards may indeed reflect an energy source's reliance on hazardous operations, but it may also simply indicate an unfortunate degree of laxity in safety practices in the specific industries involved. The appropriate societal action may not be to deemphasize the energy technology but to reform safety practices in the offending industries.

In other cases, high occupational hazards may result simply from an energy source's high labor intensity. In an economy plagued by unemployment, do we really wish to downgrade an energy option because it creates extra jobs? Surely the proper index of severity is hazard per job, not hazard per joule. Since, in fact, people not employed in energy supply will either be doing other work or be unemployed, none of which is hazard-free, it can be argued that occupational risks of energy supply should be figured on a "net" rather than a "gross" basis. That is, the average hazards to employed and unemployed persons throughout the workforce should be subtracted from the hazards per energy-related job.

However, even this "net" occupational hazard does not constitute an index of harm readily comparable

A high figure for occupational hazards may simply indicate an unfortunate degree of laxity in safety practices.

among different energy sources. Workers in some industries are substantially compensated for the extra hazards they bear, while in other industries they are not. Key factors in this distinction are how well informed the workers are about the hazards, how well organized they are, and their degree of job mobility.

Another phenomenon muddying comparisons of occupational hazards is the uneven diagnosis and reporting, from one energy source to the next, of work-related diseases. Even historical comparisons within an industry are suspect, as diagnostic techniques and reporting requirements change over the years.

In short, both workers and the process of choosing energy options will be better served by increased efforts to understand and control specific occupational hazards, rather than by further simpleminded comparisons of aggregate occupational hazards per joule based on incomplete and intrinsically incommensurable data.

"Direct" versus "indirect" hazards. Analysts, decision makers, and the public are likely to give increased attention in the 1980s to energy's "indirect" hazards—the threats to human well-being from disruptions of ecological and sociopolitical conditions. This emerging focus is a logical extension of the primary concern of the late sixties and early seventies with "direct" injuries and illnesses from accidents and effluents. People have become increasingly aware that the impact of increased atmospheric CO_2 on climate, acid rain on terrestrial ecosystems, energy boomtowns on social structures, and oil imports and nuclear exports on the prospects for war and peace could pose greater threats to human well-being than the more easily quantified "direct" hazards of accidents and toxic emissions.

The future also will bring increased attention to even subtler and broader "indirect" hazards: the adverse impacts of rich-country energy decisions on the options of poor countries, society's increased vulnerability to terrorist disruption of energy systems, the redistribution of political and economic power because of energy-supply choices, and the ecological and social impacts of energy *use* (as opposed to energy supply). These problems will be difficult to evaluate and control, but they will have to be faced if energy choices are to enhance human well-being rather than simply supply more joules.

Environment, equity, and efficiency. The distribution of environmental hazards of energy among different groups of people deserves and surely will receive more attention. If significant environmental hazards are imposed on groups far removed from those choosing the technologies and receiving the benefits, then the choices of what kinds and how much energy to use can be neither equitable nor efficient. Both equity and efficiency require that the gainers compensate the losers, but large separations in space between gainers and losers reduce the incentives for compensation, and large separations in time and the nonquantifiability of the damages make compensation impractical.

Oil, coal, and nuclear-fission technologies all tend to export major environmental burdens. By contrast, certain renewables, particularly in decentralized applications, tend to impose most of their hazards on those who use the energy or those in a position to exact compensation from the users. The societal trend toward greater concern with both equity and efficiency suggests that this advantage of decentralized renewables may eventually prove decisive. □

Further Reading

Committee on Literature Survey of Risks Associated with Nuclear Power, *Risks Associated with Nuclear Power: A Critical Review of the Literature*. Washington, D.C.: National Academy of Sciences, 1979.

Goodman, G.T., and W.D. Rowe, eds., *Energy Risk Management*. London: Academic Press, 1979.

Holdren, John P., Gregory Morris, and Irving Mintzer, "Environmental Aspects of Renewable Energy Sources." *Annual Review of Energy* 5 (1980): 241-91.

Holdren, John P., "Integrated Assessment for Energy-Related Environmental Standards: A Summary of Issues and Findings." Lawrence Berkeley Laboratory Report LBL-12779. Springfield, Va.: National Technical Information Service, October 1979.

Lowrance, William, *Of Acceptable Risk*. Los Altos, Calif: William Kaufmann Publishers, 1976.

Ramsay, William, *Unpaid Costs of Electrical Energy*. Baltimore: Johns Hopkins University Press, 1979.

John P. Holdren is professor of energy and resources at the University of California at Berkeley. He received S.B. and S.M. degrees in aeronautics and astronautics from M.I.T. and a Ph.D. from Stanford University. This article is based on work performed over the past eight years with his colleagues and graduate students in the Energy and Resources Group.

THE LEADING EDGE

#2 in a series of reports on new technology from Xerox

Few inventions have proved more versatile than the laser.

It has been used as a super signal lamp for space communications. It has found a role in exotic metal-working applications, and the incredible precision that it offers has made new kinds of brain and eye surgery possible.

A system for playing TV shows from phonograph-like disks uses a laser to "read" the recorded program material.

Lasers are used in various forms of measurement and information handling systems. For example, one version of the bar-code reader used in supermarkets employs a laser scanner.

The Hologon Laser Scanner is one of the latest developments in practical applications of laser technology. It was invented by Xerox optical physicist Dr. Charles Kramer who wrote this article.

Lasers In Electronic Printing

At Xerox we use lasers in electronic printing systems that are based on xerography. Instead of making copies of existing documents, such printers create documents, drawing on information stored in a computer. In such a system, signals from the computer pulse the laser beam as it scans across a light-sensitive drum or belt that serves as the "camera film" in xerography. The image recorded in this way is then developed and transferred to paper as in a copier.

Laser electronic printers offer the quality of offset printing with significant versatility compared with conventional computer printers. There is virtually no meaningful limit to format or to type style or size. Pictorial or other graphic material can be printed as easily as text. Arabic, Greek or Russian alphabets—even Oriental ideograms—are within its capabilities, provided appropriate programming is fed into the printing system.

Equally significant is the fact that, with electronic printing, documents originated in one location can be printed simultaneously at a number of different locations.

Xerox currently offers three such systems. The 9700 electronic printing system turns out almost two pages per second and has almost unlimited flexibility when it is used with the Xerox Integrated Composition System program. The 5700 electronic printing system is up to 40 times faster than conventional word-processing printers, which it can replace, and it can also be used for electronic mail and remote computer printing. A similar printer is offered as part of the Xerox 8000 network system. Designed for lower-volume applications, it is twelve times faster than a conventional word-processing printer.

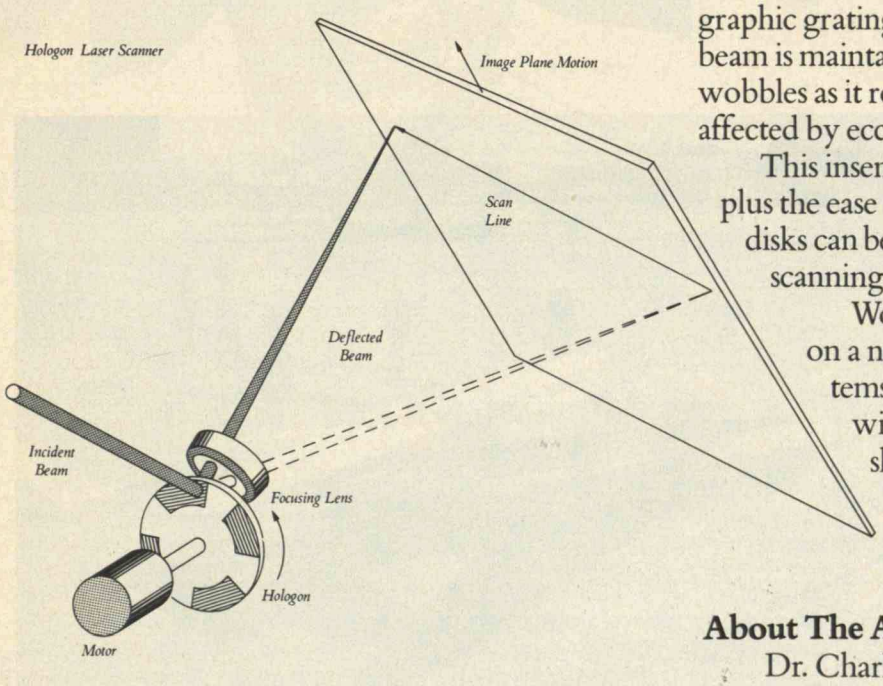
In these printers, the scanning action of the laser beam is created by a relatively complex opti-

cal system that is based on a rotating, polygonal prism. Extremely high precision is required in such a system. This complexity and precision make such a laser scanner relatively expensive.

The Hologon Laser Scanner

To simplify laser scanners and reduce their cost, we considered holography to perform the functions of costly lenses and prisms.

Holographic recordings, best known for their reproduction of three-dimensional images, take the form of gratings—corrugated or ridged patterns on a transparent medium, having a spacing of approximately twenty millionths of an inch. In pictorial holograms, these gratings contain the recorded cross section of the wavefront of light



that had been reflected from the pictorial subject. When coherent light—usually from a laser—is transmitted through such a hologram, a true three-dimensional image of the subject is reproduced.

However, the holographic gratings used in a Hologon scanning system do not contain pictorial information. Only the optical diffraction properties of the gratings are utilized.

The Hologon System is one of several holographic approaches to scanning. But the others tend to scan in an arc-like pattern which is unsuitable for electronic printing, which requires a straight-line scan, much like the raster pattern used in television to create an image. The Hologon approach gets around this problem through a novel configuration.

In a Hologon, a series of holographic gratings are formed around the circumference of a transparent disk. A laser shines through these gratings as the disk rotates. The gratings diffract the laser light, and the rotating action causes it to scan across the surface on which it is focused, as shown in the accompanying diagram. Focusing is done by a simple, inexpensive lens.

The laser beam in this system is aimed so that it forms a nominal 45° angle to the Hologon's surface as it enters a grating and a 45° angle as it emerges from the grating. In other words, it is diffracted through a right angle by the gratings. This angling results in a straight-line scan.

Because of the optical properties of the holographic gratings, the 90° diffraction angle of the beam is maintained even if the Hologon surface wobbles as it rotates. The beam angle is equally unaffected by eccentricities in the rotating disk.

This insensitivity to mechanical variation, plus the ease and low cost with which Hologon disks can be produced, make a Hologon laser scanning system relatively inexpensive.

Work is currently underway at Xerox on a new generation of laser printing systems utilizing the Hologon laser scanner with all its attendant benefits. This should enable Xerox to make the advantages of electronic printing more widely available than ever before.

About The Author

Dr. Charles Kramer is the inventor of the Hologon Laser Scanner. He is an optical physicist specializing in electro-optical reading and printing devices at the Xerox Joseph C. Wilson Center for Technology in Rochester, New York.

He holds a Bachelor's degree and a Master's degree in Physics from Fairleigh Dickinson University and a Master's degree and Ph.D in Optics from the University of Rochester.

XEROX

TRENDS

Aviation

Cleaner Sweep Taking Wing

Isn't that wing on crooked? At speed aloft, the AD-1 appears about as airworthy as a pair of tin snips. When its movable wing is positioned obliquely to its fuselage, the 38-foot-long twin-jet research aircraft appears unsettlingly counterintuitive.

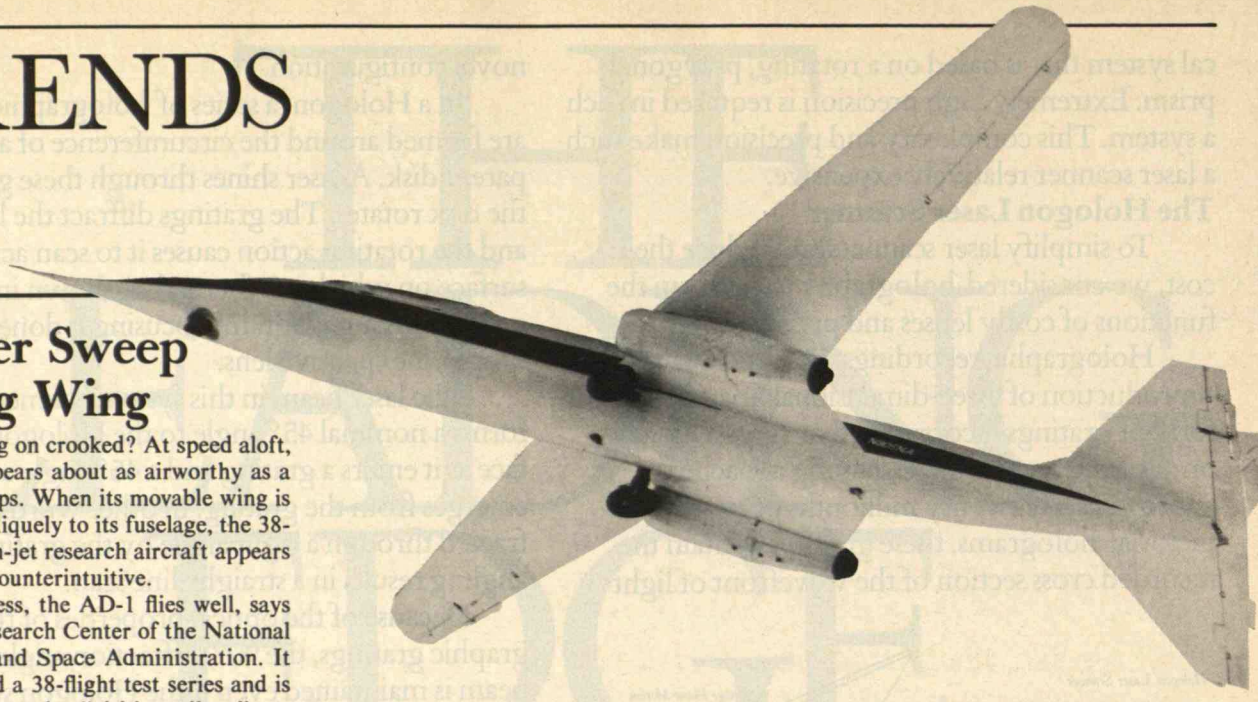
Nevertheless, the AD-1 flies well, says the Ames Research Center of the National Aeronautics and Space Administration. It has completed a 38-flight test series and is now being flown by "visiting pilots," according to Ralph Jackson of NASA's Dryden Flight Research Center, where it is hangared.

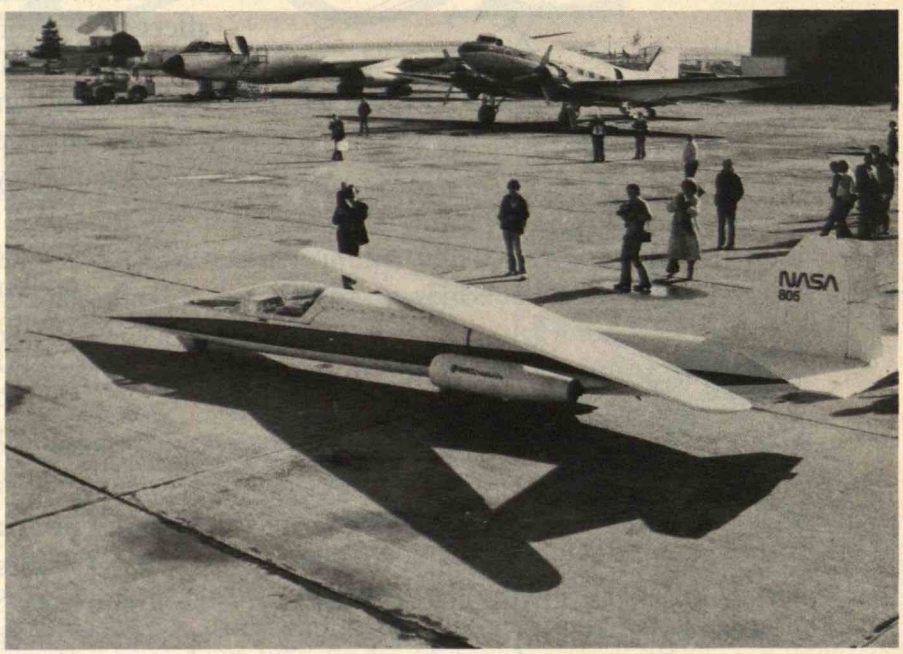
The AD-1 embodies another of the revolutionary aircraft designs of Robert Thomas (R.T.) Jones; he's also the inventor of the swept-back wing and slender "delta" wing that grace virtually all of today's high-speed military and civilian jets.

Jones and NASA believe that the new oblique-wing concept can sidestep two of the most serious problems of today's supersonic aircraft: sonic booms, and poor lift at low speeds (and hence prodigious fuel consumption). Wind-tunnel tests of model aircraft have borne out Jones' theory: one aircraft with its wing set at 45 degrees to the fuselage produced an "extraordinarily low" lift-to-drag ratio of 20 to 1 at Mach 0.98 (0.98 times the speed of sound under test conditions). Jones and NASA also strongly suspect that a highly yawed oblique wing will make possible supersonic flight without a sonic boom. The shock wave that causes the boom results from a pressure buildup that increases with the aerodynamic volume of an aircraft. An oblique wing "stretches the volume" fore and aft, minimizing the pressure buildup, says Thomas Gregory, who ran the wind-tunnel tests.

The AD-1 is the first step in implementing and testing the oblique wing theory. Built at a cost of about $218,000 (very low for a hand-built twin-jet plane), the aircraft can attain a speed of about 150 knots in level flight, according to Ralph Jackson.

The Ames Research Center calculates that a full-size supersonic transport (SST) built with an oblique wing could cruise at about 1,000 miles per hour. On a typical flight, it would burn only about half as much fuel per passenger as the world's present-day SSTs, the French-British Concorde and the Soviet TU-144 Charger.



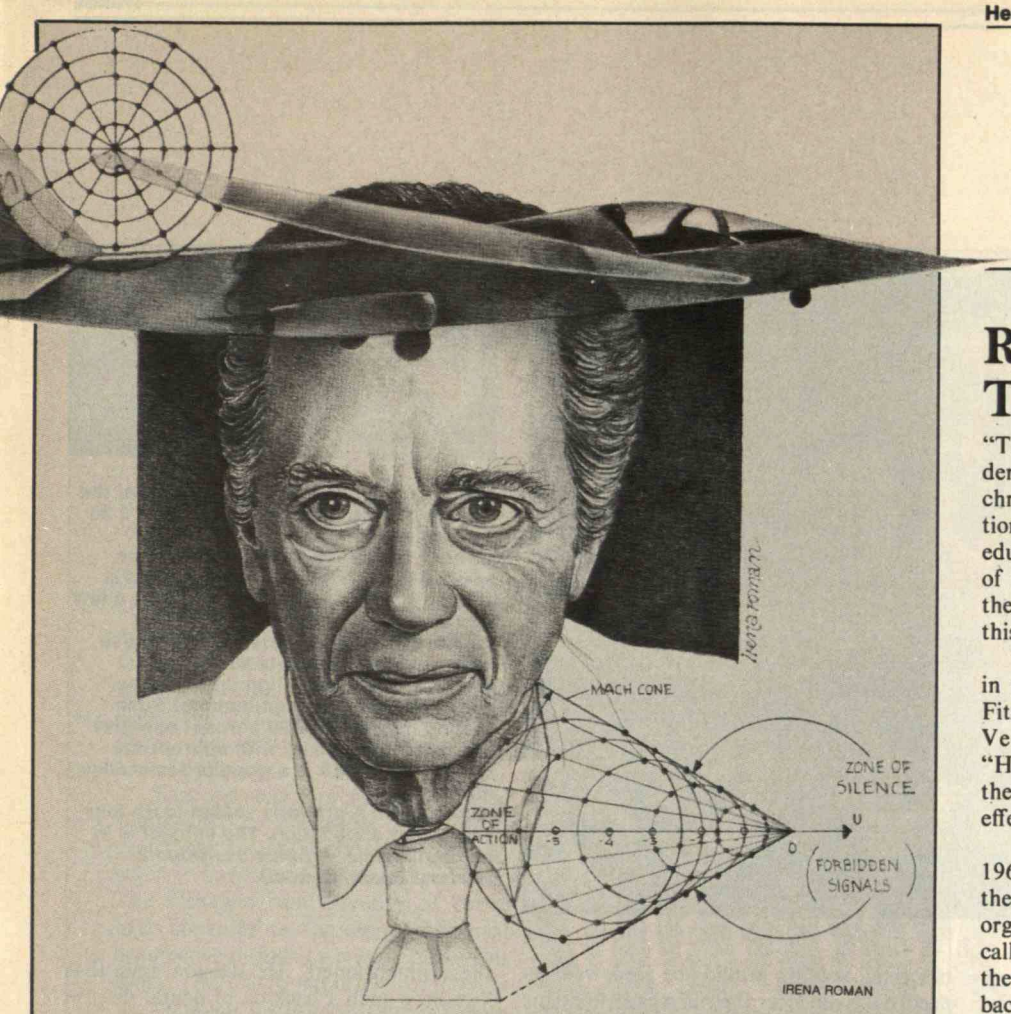


PHOTOS: NASA

Upper photo: **The NASA AD-1 research aircraft in flight. At takeoff and landing, the pivoting, "oblique" wing is perpendicular to the fuselage; at high speed, it can be rotated to angles up to 60° to the fuselage.** ***Lower photo:*** **The AD-1 with its wing set at 60° from the perpendicular. In effect, says NASA, the oblique wing "stretches out" the area of the aircraft, reducing drag significantly.**

If an oblique-wing SST were to fly nonstop from New York to Honolulu, NASA calculates that total flight time would be 5 hours and 45 minutes and fuel consumption 1,000 pounds of fuel per passenger. A Concorde or TU-144 would require 6 hours and 45 minutes and 2,000 pounds of fuel per passenger to make the same flight. Despite the Concorde's superior top speed (about 1,500 miles per hour, compared with the oblique-wing's 1,000 miles per hour), it would be constrained to subsonic speed during its transcontinental leg to avoid causing a sonic boom; the quieter oblique-wing aircraft would be allowed to fly faster than sound. Adding to the delay, the fuel-guzzling Concorde would have to refuel on the West Coast.

NASA would like to fit a Navy F-8 fighter with an oblique wing as the next necessary step toward the SST version, or perhaps a family of fuel-efficient military patrol aircraft and corporate jets. "We've taken the intermediate steps," says Gregory. But it won't happen soon, says Jackson, because of lack of funding.—*L.A.P.* □



Profile of an Aviation Pioneer

The climb of R.T. Jones to notoriety in aviation design makes for as remarkable a story as that of the oblique wing, his latest innovation. His accomplishments are all the more noteworthy in this age of university-trained technologists because he never finished college. He completed only his freshman year at the University of Missouri (in 1928), but the University of Colorado awarded him an honorary doctorate of science in 1971.

After leaving college, Jones worked for a year with a flying circus and another with a small aircraft maker, which folded. Meanwhile, he designed a race plane and in the process mastered Max Munk's *Fundamentals of Fluid Dynamics for Aircraft*. In 1930, as an elevator boy in the U.S. House of Representatives, Jones was primed for success at an apocryphal meeting with Munk, a senior member of the National Advisory Committee for Aeronautics (NACA—the precursor of NASA) and influential in aviation circles.

The story goes that Dr. Munk stepped into the elevator and Jones immediately recognized him. The young man's obvious command of aircraft theory intrigued the noted scientist, who soon after arranged to give Jones an oral exam, which he passed with flying colors. Jones subsequently found himself enrolled by his mentor in graduate aviation and physics courses at Catholic University.

In 1934 Jones landed a job with NACA's Langley Memorial Aeronautical Laboratory in Virginia (now Langley Research Center). Ten years later he announced his theory of swept wings for high-speed jet flight that was to profoundly affect the design of such aircraft. (Not until after the war did the Allies learn that swept-wing configurations had been considered for advanced aircraft designs by the Axis.)

Jones has received numerous prestigious awards, including the Sylvanus Albert Reed Award of the American Institute of Aeronautics and Astronautics in 1946, the German Prandtl Ring Award in 1978, and the President's Award for Distinguished Federal Civilian Service and the Smithsonian Institution's Langley Award in 1981.—*L.A.P.* □

Rooting Out Tooth Rot

"There are no good medical reasons why dental caries must continue to be a leading chronic disease of nearly epidemic proportions," Alice M. Horowitz, public-health educator with the National Caries Program of the National Institutes of Health, told the AAAS annual meeting in Washington this January.

Tooth enamel is the most durable tissue in the human body, noted Dr. Robert J. Fitzgerald, chief of dental research in the Veteran's Administration in Miami. "However, nature has selectively endowed the most formidable enemy of teeth with effective tools and defenses."

That major culprit, fingered in the 1960s, can be stymied: acids produced by the bacterium *Streptococcus mutans*. The organism's preferred diet is sucrose. Typically *S. mutans* initiates decay, which may then be exacerbated by the action of other bacteria.

Horowitz stated that two proven procedures, in addition to regular brushing and cleaning, could together deliver a knockout punch to tooth decay: the application of fluoride and the chemical sealing of fissures on the occlusal, or biting, surfaces of posterior teeth.

The National Caries Program of the National Institute of Dental Health (NIDH) has found that children who rinse their teeth weekly with 0.2 percent solution of sodium fluoride, or who take a daily fluoride dietary supplement, can lessen their chances of developing caries by about 35 percent. Fluoridated toothpastes may produce a reduction of up to 20 percent. Indeed, "the use of fluorides is regarded as the cornerstone of modern preventive dentistry," notes Dr. Gary M. Whitford, associate professor of oral biology in the Medical College of Georgia in Augusta. "Based on years of basic and applied research," he says, "it is now recognized that no other agent is as effective in the control of tooth decay."

Fluoride works by inhibiting the production of acid by oral bacteria. It also promotes the remineralization and smoothness of enamel by increasing the rate of uptake of calcium and phosphate in an acidic environment, explains Dr. Whitford. This cavity-fighting capability, first noted in 1908, has since been found mainly to protect the smooth surfaces of teeth.

Left: **Scanning electron micrograph of the surface of tooth enamel etched with a 30 percent phosphoric acid solution for about 2 minutes in preparation for the application of adhesive sealant. Field is about 30 x 50 micrometers; pitting is a few micrometers deep.**
Above left: **Colorless Bis-GMA adhesive sealant being applied to the biting surfaces of a tooth. (Pigments may be added to facilitate examination.) Such sealing may be over 90 percent effective against caries. Mixed with appropriate "fillers," Bis-GMA is a popular restorative material.**
Above right: **A properly sealed tooth four years after application. The subject is in her early teens.** ***(Photos: I.L. Dogon, Harvard Dental School)***

The gap in protection can be filled by an adhesive developed in the 1960s called bis-GMA (a monomer produced by the combination of bis- [4-hydroxyphenyl] dimethylmethane and glycidyl methacrylate), which can be used to seal and dramatically protect the uneven occlusal surfaces. Dr. I. Leon Dogon, professor of dentistry at the Harvard Dental School and an authority on bis-GMA, notes that the material is widely used in the restoration of damaged teeth. He reports that bis-GMA adhesive is ideally suited and commonly used for fixing restorations made of bis-GMA to a damaged tooth. Not only is the resulting bond exceptionally strong, but the remaining natural tooth in contact with the bond is protected from decay.

The adhesive sealant is applied after the surface of the tooth is etched with acid to remove surface contaminants and about 5 micrometers of enamel. The process creates a bees'-nest pattern of micropores on the enamel surface into which the sealant resin penetrates and polymerizes. The pitting is trivial, explains Dr. Leon M. Silverstone, professor of cariology at the University of Iowa, and reportedly disappears within an hour or so if sealant is not applied.

The bond can be extremely tenacious: bonding failures occur within an hour or generally not at all, says Dr. Silverstone. In clinical trials still in progress, 60 to 80 percent of single applications of sealants has been retained after six years (in ordinary practice, sealant would be renewed as needed). Even after the main cap of sealant is worn away, hairlike "tags" of hardened sealant anchored in the micropores render the host enamel highly resistant to decay. (Contrast conventional silver amalgam fillings, which eventually break down at their juncture with the enamel).

A properly sealed tooth has a better-than-90-percent chance of remaining caries-free for years. Dr. Silverstone estimates that an unprotected first molar is about 23 times more likely to develop caries than a sealed one. He told the AAAS that sealant has slowed the rate of decay by an amazing 2,000 times after two years in previously decayed teeth. (Dr. Dogon notes that such teeth are not generally sealed in his research, but confirmed that slight decay, occasionally undetected, does indeed appear to be arrested by sealing.)

Yet despite the promise, sealant technology is being used by only about 10 percent of dentists, according to the American Dental Association. Dr. Dogon teaches the technique at the Harvard Dental School and would like to see it adopted "on a public-health scale." He attributes the "disappointing" rate of acceptance to several factors:

☐ Three out of four practicing dentists graduated from dental school before the technique was developed.

☐ Some dentists might believe that the cavity-fighting effectiveness of sealants could threaten their future practice. To these practitioners, Dr. Dogon says that "we have such a backlog of dental disease in the world that we have to make some headway; there are little-understood periodontal diseases and orthodontal problems, among others. I don't think dentists will starve."

☐ The public is generally unaware of the technique; in addition, people tend not to invest in preventive techniques during these difficult economic times. He emphasizes that the price of sealing a tooth is "at most comparable" to filling a cavity; the experience is also far more pleasant.

☐ Public-health programs are limited by costs, and fluoridation is more cost-effective than fissure-sealing.

According to Dr. Gregory N. Connolly, director of dental health for the Massachusetts Department of Public Health, the problem behind slow acceptance is more political than medical. He recommends establishing additional fluoride-treatment programs before turning to sealants: "You walk before you run," says Dr. Connolly. (His department rates the effectiveness of tooth sealants as "fair to poor.")

While the controversy continues, we may take some comfort in two observations: the NIDH report that over the past ten years the number of cavity-free children in the U.S. increased by 9 percent; and the reassurance of Dr. William H. Bowen, chief of caries prevention and research at NIDH, that "fortunately, dental caries have never killed anyone."—*L.A.P.* ☐

The Sugar Connection

"The positive relationship between sugars and dental caries is not likely to be questioned seriously by any professional in dental public health," says James H. Shaw, professor of nutrition at the Harvard School of Dental Medicine. Statistical data on the occurrence of caries—including from teeth in human skulls thousands of years old—show that the association between tooth decay and sugars has persisted since antiquity.

The prevalence of decay increased significantly, if modestly, from medieval times to the seventeenth century, when it began to accelerate markedly. The frequency and severity of caries have increased to "an almost universal occurrence in today's industrialized nations," Dr. Shaw reported recently to the National Institute of Dental Health (NIDH). During the intervening centuries, refined flour and sugar became increasingly popular, first among the affluent and subsequently among low-income groups (notably during the nineteenth century) as a result of improved transportation.

Total world sugar production at the beginning of this century was about 8 million tons; by 1980 it had grown to 80 million tons. (The average American consumes about 128 pounds of sugar annually, according to the U.S. Department of Agriculture.) Not surprisingly, precipitous rises in caries have resulted both in industrial nations and in developing countries that have adopted Western menus. Some examples of the latter:

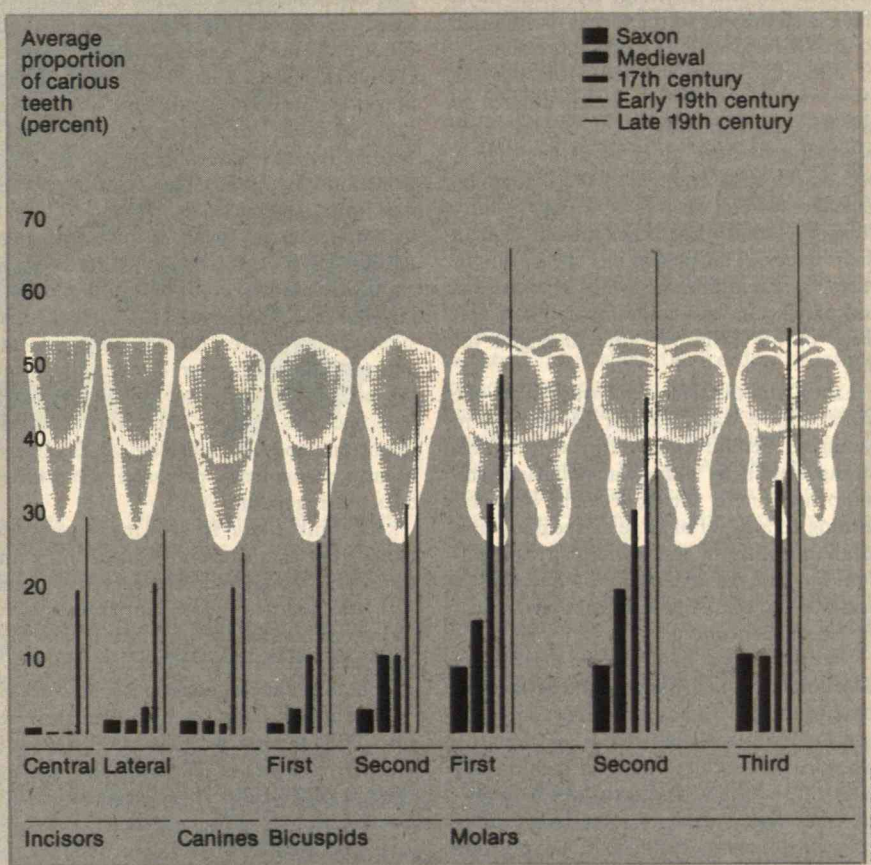
☐ A tenfold increase in caries in some African nations during one decade. D.E. Barnes, chief of the oral health division of the World Health Organization, notes that this development accompanied a tenfold increase in the amount of sugar "available" in those nations.

☐ An 83.3 percent rate of caries in one group of Eskimo men who live near a trading post selling processed and sweetened foods at Julianehaab, Greenland. This compares with a 31.8 percent rate for those in native settlements.

☐ A 43.2 percent caries rate among Eskimo men living near trading posts in Angmagssalik, Greenland, compared with a 4.3 percent rate for their peers living in native settlements.

Dr. Shaw also describes striking reductions in the occurrence of tooth decay among children of 10 European nations during the two world wars. These reductions correlate with drastically reduced imports of sugar and refined flours and a reliance on homegrown products such as root vegetables.

The message for those who would eschew tooth decay by modifying their diet is clear, but it is not an easy prescription to follow. About three-fourths of the sugar consumed by Americans is introduced into food during the manufacturing process; only the remaining one-fourth is discretionary for the average supermarket shopper.—*L.A.P.* ☐



The prevalence of caries in permanent teeth from the Saxon era to the late nineteenth century in England. The chances of developing decay in molars grew from about 7 percent to nearly 70 percent during that period. Meanwhile, annual world production of sucrose grew from essentially nothing to about 8 million tons; today, it is 80 million tons. (*Data: James H. Shaw, NIDH*)

Nervous Attack

For 20 years, Billie Moss worked in the Bunker Hill Co. mines in Kellogg, Idaho. It was a convenient job; the smelter was so close to his home that he could smell the fumes wafting out "like the smell of burnt matches" in the morning. On some days, the gas cloud was so thick that drivers had to use their headlights long before sunset.

But what really worried Moss was the effect the chemical fog seemed to have on his five children, some of whom were beginning to show signs of ill health. He became anxious enough to drive them to Chicago, where doctors at Cook County Hospital found large quantities of lead in their bones. The poisoning, the result of years of breathing lead-heavy emissions and playing in lead-contaminated soil, left three of his children brain damaged for life.

Last October, after a six-week trial, the Moss family was awarded $1 million in damages, the first time victims of lead poisoning caused by industrial pollution won compensation in the courtroom. But according to a panel of experts speaking at a recent meeting of the American Association for the Advancement of Science, it won't be the last. And lead, they say, is just the tip of the iceberg.

Heavy metals such as lead have been associated with neurological and behavioral toxicity since antiquity. Everyone has heard tales of mad hatters, whose lengthy exposure to mercury (used in making felt hats) caused them to show signs of insanity. Manganese miners sometimes suffer from "manganese madness," a syndrome resembling Parkinson's disease. But these metals are only a part of the neurotoxicity problem, which researchers say is extremely dangerous and pervasive.

"How is it possible to determine the impact of environmental contaminants whose action is subtle and insidious, extends over many years, and, in the end, is revealed by an impairment of function, not physical pathology?" asks Bernard Weiss, professor of toxicology and environmental health at the University of Rochester School of Medicine and Dentistry. "Suppose that thalidomide, instead of promoting missing limbs, lowered the I.Q. of affected children by an average of 10 percent? Would we even now suspect any adverse effects of the drug?"

Neurotoxic symptoms vary widely, from vague complaints such as depression and lack of energy to overt neurological disabilities, including retardation and psychosis. These symptoms are difficult to detect, difficult to quantify, and difficult to trace. But because neurotoxic concentrations and exposures are generally highest in the workplace, control efforts are focused on their industrial use.

Kent Anger, a physiological psychologist and chief of the neurobehavioral research section of the National Institute for Occupational Safety and Health (NIOSH), says there are 33 different known neurotoxins and "probably a few hundred more" that have yet to be identified. Different chemicals produce different behavioral symptoms that require specialized tests for detection, he says. Thus, it makes little sense to advise industrialists to perform one or two of these tests on all employees. However, by carefully monitoring workers, employers can detect early signs of neurological disorders and relocate affected individuals, or discontinue using the offending substance, before the problem becomes acute. This is particularly important because neurological damage is usually permanent—poisoned nerve tissue does not regenerate itself.

"I think there is growing interest in monitoring as a preventive measure," Anger says. "Companies are very concerned with the health of their employees for a variety of reasons. In fact, one of our biggest duties has been to tell companies what's safe before the regulatory agency does."

The government agency ultimately responsible for regulating these substances is the Environmental Protection Agency (EPA). But while the Toxic Substance Control Act of 1976 mandates that neurotoxins be monitored and controlled by the EPA, so far the agency has not published guidelines for their use.

"The EPA has not developed a standard set of procedures for detecting behavioral problems and therefore cannot regulate neurotoxins," says Bambi Batts Young, director of the environment and behavior section of the Center for Science in the Public Interest. "Behavioral tests are complicated, but in fact a number of tests could be applied. For example, we can test animals for activity level, memory, and cognition (after exposing them to the suspected chemical). These tests aren't perfect, but they're certainly better than nothing. As of now we're not protecting anyone from neurotoxic effects."

Bill Sette, a psychologist who is one of the two EPA employees responsible for drawing up written standards for testing chemicals for neurotoxic effects, admits that there are no regulations to control the use of known or suspected neurotoxic chemicals in industry. He blames understaffing and mismanagement at all levels of the EPA, as well as a general lack of enthusiasm for the research both inside and outside the agency.

"Of course, some industries are not anxious for regulation," he says. "But the main problem is bureaucratic incompetence within the EPA. The whole standards process has been mismanaged—it's a joke, a Rube Goldberg mess." (*See "Reagan's EPA: The New Fuddyduddyism," p.11.*)

Sette says he has written three standards for testing suspected neurotoxins in animals, each of which entails a specific protocol designed to detect different signs of neurologic malfunction. But none of these standards has become law. "Right now," Sette says, "we're in limbo. I don't even have any idea when these standards will be published."

But while little is being done to regulate neurotoxic substances, concern over their proliferation is growing. More and more neurotoxins are being identified, the most recent being a class of solvents that causes peripheral neuropathy (loss of sensation and control in the extremities) after relatively short exposures. A NIOSH study published in 1975 found that 70 percent of workers exposed to these solvents in the paint industry had some neurological complaint, but even this evidence was not enough to prompt legal action.

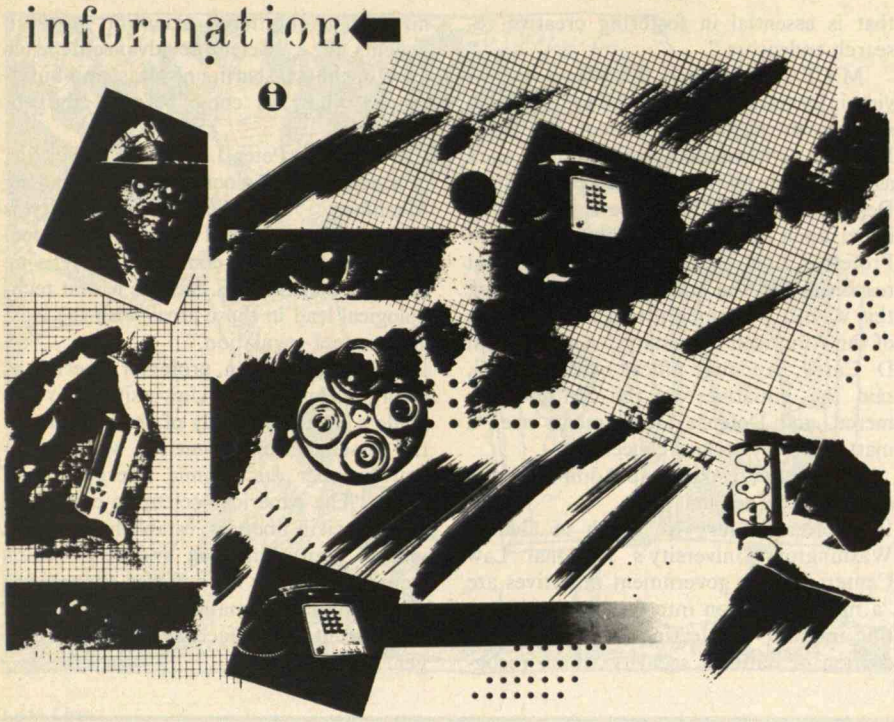
"When people think about toxins they think about physical, not neurological, effects," explains Dr. Young. "But neurological damage can be just as devastating. It might be more difficult to understand problems of the body's function as opposed to its structure, but it's about time the public was informed of the dangers of exposures to neurotoxins and allowed to make their own decisions concerning their use."—*E.R.S.* □

Technology Transfer

The Rising Tide of Protectionism

Threats of federal constraints on the free flow of information about unclassified technology are proliferating, raising growing alarm among scientists and engineers—it is "a terribly dangerous game," says Francis E. Low, provost of M.I.T.

Professor Low's comment was in response to one of the strongest government statements on the subject so far. Embol-



TIM BARKER

dened by what he said is a rising tide of public and legislative opinion, Admiral Bobby R. Inman, deputy director of the Central Intelligence Agency, told the American Association for the Advancement of Science in January that there must be a broadened federal role in protecting "information necessary to safeguard our society."

It is now "thoroughly documented," Admiral Inman declared, that "the bulk of the new technology that the Soviets have employed [in their military buildup] has been acquired from the United States." He described it as "a hemorrhage of this country's technology" and promised a "tidal wave of public outrage."

Admiral Inman warned that solutions legislated in response to strong public pressure are not likely to find an appropriate balance between scientists' desires for unconstrained communication and the government's need to protect sensitive information from foreign adversaries. So he hopes for voluntary cooperative agreements like those developed by cryptographers, the National Security Agency (NSA), and the National Science Foundation last year (*see "High Technology: Back in the Bottle?" August/September, page 76*). In essence, Admiral Inman wants scientists working in sensitive areas to submit papers and reports for security review before they are published, and to delay or forego publication if requested. He also suggests that "the question of potential harm to the nation" be addressed in the peer review of research proposals and covered in research contracts. Presumably the investigators would voluntarily accept restrictions on publication if such potential were found.

Such arrangements seem to M.I.T. observers to be the most likely mechanisms for government control of information about unclassified but "sensitive" new technology. Admiral Inman told the AAAS he would like to extend the voluntary cryptography arrangement to papers on computer hardware and software, other electronic gear and techniques, lasers, crop projections, and manufacturing processes.

Admiral Inman's list may soon grow: the Department of Commerce is sponsoring an interagency review to assemble a list of "militarily critical technologies." Under the Export Administration Act of 1979, Commerce may restrict or prohibit certain exports—including technologies—to protect national security, implement foreign policy, or conserve supplies of critical materials.

Admiral Inman was not alone in fueling scientists' fears about the freedom of information exchange, the cornerstone of U.S. science and engineering. In the same week Frank C. Carlucci, deputy secretary of defense, warned the AAAS that the Defense Department "views with alarm . . . blatant and persistent attempts" by the Soviets to collect U.S. technological information. Mr. Carlucci believes it is "possible to inhibit this flow without infringing upon legitimate scientific discourse," and he implied that the Pentagon will soon move to do so. And Daniel C. Schwartz, a

Hard Questions for the Universities

These are the questions posed for U.S. research universities by current federal initiatives to control international flows of technology, says George A. Dummer, director of M.I.T.'s Office of Sponsored Programs:

☐ If universities accept the inclusion in research contracts of guidelines for handling specific areas of critical military concern, how shall they be implemented? Must we, for example, seek export-control licenses for each export of data falling within the guidelines?

☐ Can members of the university community and the federal government agree on operating procedures to protect legitimate needs of national security without adversely affecting the traditions and values of the university? Must universities, for example, agree to obtain the permission of contracting officers before foreign nationals participate in campus research projects?

☐ Will we affix to certain publications and theses the typical statement on export-control limitations, such as "This document is subject to export controls and each transmittal to foreign governments or nationals may be made only with the prior approval of the controlling office of the Department of Defense"? Will this constitute an area of pseudo-classification that universities have no mechanism for implementing?

☐ If, on the other hand, we choose to accept research support in only those areas that appear to have little chance of leading to controlled data, will this affect 1 percent or 55 percent of the total research program?

☐ Will controlled technologies proliferate?

Washington lawyer who was general counsel for the National Security Agency during the cryptography issue, agreed that "such cooperative management . . . may well serve as a model."

Parallel constraints are also threatened on educational activities involving foreign nationals who are official visitors or students. Recent State and Commerce Department inquiries about academic and research activities of foreign students have been rebuffed by a number of universities, including M.I.T., Minnesota, and Stanford. Responding to the Commerce Department on a Chinese visiting scholar's activities, Professor Gerald Lieberman, Stanford's dean of graduate studies and research, insisted that the campus environment is and must be "completely open, with no means to prohibit access by foreigners to the broad spectrum of university activities. Even if we had the means to monitor or police the activities of any subgroup of scholars, such actions would drastically disrupt the academic environment that is essential in fostering creative research endeavors."

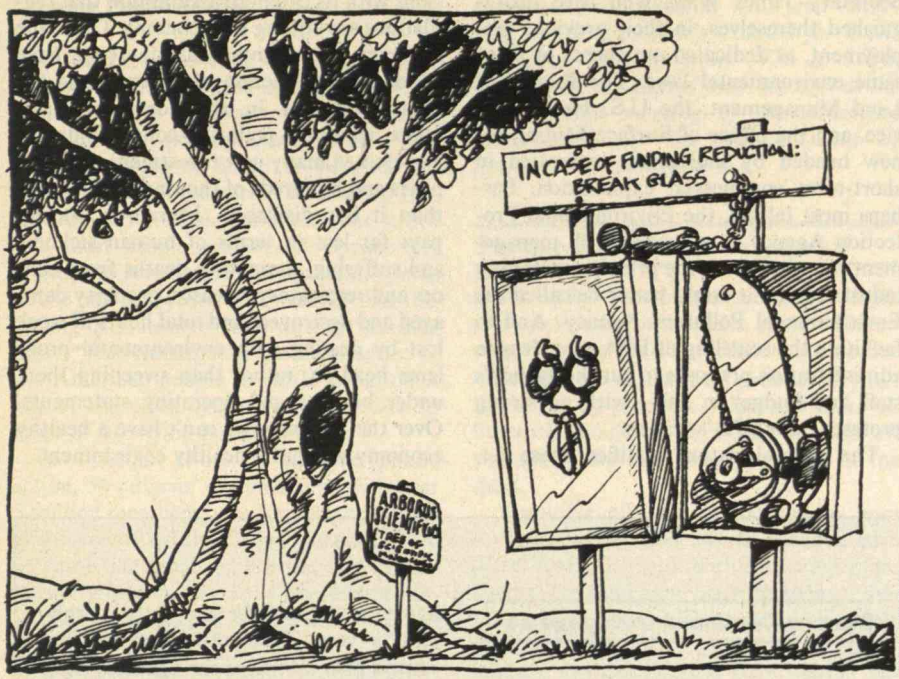
M.I.T. refused early this winter to provide information on activities of a Chinese student in physics. President C. Peter Magrath at Minnesota said inquiries such as those made at his institution by the State Department "can only have a chilling effect upon the academic enterprise," and Professor Low had a similar unequivocal response: "If the country is really going this way, it will amount to a restructuring of the American university." And William D. Carey, executive officer of the AAAS, said the initiatives by the State, Commerce, and Defense Departments are "a matter of very serious concern."

Among the responses to Admiral Inman at the AAAS session:

☐ Professor Mary M. Cheh of George Washington University's National Law Center: Recent government initiatives are "a major intrusion into freedom of scientific inquiry," neglecting "a broader conception of national security which recognizes that unfettered scientific research benefits all . . . Scientific advance depends upon openness, sharing of ideas, and building on what has come before," she observed.

☐ Professor Peter J. Denning of Purdue, president of the Association for Computing Machinery: "The scientific community is increasingly concerned about a new protectionist mood in the country. . . . It is no accident that the U.S. has the widest technological lead in those areas with the least government regulation."

☐ Harold P. Green, professor emeritus at George Washington University who has made a long-time study of the controls on the dissemination of nuclear weapons research under the Atomic Energy Act of 1956: "The American scientific community, the civil liberties establishment, and indeed even American industry, which from time to time has suffered suppression of research, has remained anesthetized and acquiescent in the face of this latent danger."—*J.M.* ☐



JON McINTOSH

Last Line

Pruning the Tree of Knowledge

"We cannot expect to be preeminent in all fields," Dr. George A. Keyworth (President Reagan's science advisor) told the AAAS last January during his keynote address. "We must sharpen our focus and make a concerted effort to allocate our resources in ways that support the most superior, promising, and relevant efforts."

His message was clear: the government's limitless gravy train is no more. Scientists and engineers must choose: not only what to research and develop within given fields, but across all of them. And they must earnestly involve themselves in this "exercise in priority setting" as well, Keyworth warned. Otherwise, those with "less acuity" will do it for them.

In a public lecture on the following day, Bell Laboratories' President Ian M. Ross both complemented and contradicted Keyworth's advice. Noting that the scientific preeminence of the United States has been a relatively recent phenomenon—"until about 1930, the U.S. was a scientific backwater"—he acknowledged the current hard times, both in terms of budgetary constraints and diminishing confidence, and reminded his listeners of the four "environmental factors" that sustained America's 50-year reign: a stable and vigorous economy; abundant natural resources; free competition of ideas ("unrestricted by political orthodoxy"); and a healthy balance—"both reinforcement and competition"—among government, industry, and universities.

Ross expressed confidence that the combined efforts of professionals in the public, private, and academic sectors could revive this "pioneer spirit"; he claimed, in fact, that it has never really expired. But it is difficult to maintain confidence, raise morale, or insist convincingly that nothing has changed when the administration, via Keyworth, has just been telling the same audience to "face up to the difficult choices because we know that federal expenditures for science cannot and will not continue to grow in the way they have in the previous three decades."

Few are opposed, in principle, to "a selective emphasis and deemphasis," or to the "occasional pruning of a tree," to use Keyworth's terms. But when the relatively modest budgets of the NSF or NASA are cut back (*see "Balancing the Space Effort," page 6*), and a virtual blank check is handed to the Department of Defense for its scientific programs (with a 21 percent increase in its R&D budget from fiscal year '81 to fiscal year '82), suspicions are aroused that the "resource allocation" process within the executive branch is a rather poor model for the scientific community to follow.

Supporters of swollen allotments for R&D within the defense budget maintain that while this is the government's proper domain, the private sector should provide prominent, sometimes exclusive, support for other kinds of R&D—especially those that could eventually stimulate the economy. But the administration may be overestimating the power of the marketplace just as it is underestimating the power of—and overcompensating—the military. Science and technology can certainly be more business-*like*, but they cannot be run like businesses.

Keyworth asserts that "we are interested in results, [in] what gives us the most return for the dollars spent," and that industry will compensate for the pullout of federal support from so much of the research and training functions of universities. "It is clearly in the best interests of 'the consumer' to take the necessary actions to ensure that its needs are met," he says. But he implies a confidence in "the marketplace" that, given the radical changes under Reagan, is unrealistic. "The problem is not so much the *reductions* in government support," says Ross, "but their rapidity." A marketplace, like any "organism," can respond well to gradual changes, but will often balk, or go into shock, when the changes are too many or too fast.

It is not just the "healthy balance" among Ross's "four factors" that is being shortchanged; "free competition of ideas" is also under siege. Ross recalled that during the first few months after the invention of the transistor at Bell Labs there was serious federal thought about classifying it. Instead, it was deemed a stimulus to further innovation, and the rest, as they say, is history. "It is painful to think what a less wise government would have done," he said. But the increased federal pressure for secrecy these days—about microelectronic advances in particular and virtually any technology with a conceivable military application in general—suggests strongly that a "less wise government" may indeed be prevailing. (*See "The Growing Threat of Government Secrecy" by Stephen H. Unger, February/March, page 30*).

It is certainly true, as Keyworth says, that "reductions in support of a research area do not necessarily lead to a proportional reduction in research output." And he is prudent in counseling scientists to use discrimination in simultaneous pursuit of excellence and pertinence. But it is still unclear whether the administration's game plan is pruning—or hacking away at—the tree of scientific knowledge.—*S.J.M.* □

Peterson/Continued from page 11

natives to the proposed action (including no action), and required public involvement. Despite its imperfections, NEPA has had profound effects across the nation and has been copied by many other countries. It represents the beginning of wisdom in the way we deal with nature.

The environmental impact statements brought into the open the perennial conflict between exploiters of our natural resources interested in making a buck today and those who focus on the broader and longer-term interests of society. The National Audubon Society was created early this century to fight such an issue—to stop commercial plume hunters from wiping out plumed birds—and stop them it did. But the plume-hunter mentality still plagues us.

This mentality is the dominant view in the Reagan administration and is devastating the advances made in the 1970s toward protecting the environment. Witness the mad rush to develop federally protected wildnerness areas, weaken air and water pollution controls, drain biologically rich wetlands, pave over prime farmland, flood agricultural valleys, overcut national forests, and drill for oil and gas in sensitive offshore areas—much of which is done without properly assessing the environmental consequences beforehand.

This attitude is also exemplified by staff appointments to the federal agencies that oversee the nation's natural resources. Industry now seems to be running the regulatory show in Washington. Of the key positions created by Congress to carry out the environmental laws of the land, almost all have been filled by people such as Interior Secretary James Watt, who have distinguished themselves, in their previous employment, as dedicated opponents of these same environmental laws. The Bureau of Land Management, the U.S. Forest Service, and the Office of Surface Mining are now headed by individuals interested in short-term commercial exploitation. Perhaps most telling, the Environmental Protection Agency is so loaded with management recruited from the principal polluting industries that it might better be called the Environmental Polluters' Agency. And to facilitate the scuttling of EPA, the Reagan administration proposes to cut the agency's staff and budget in half—with no strong protests from EPA's leaders.

The administration justifies these actions with its catch-all assumption that regulations are stifling the economy. Quite the contrary. Environmental controls have added only a fraction of 1 percent to the annual increase in the consumer price index, while the pollution-control industry has created many new investment opportunities and hundreds of thousands more jobs than it has displaced. Moreover, society pays far less in terms of human sickness and suffering, premature deaths from cancer and respiratory diseases, property damaged and destroyed, and total hours of work lost by dealing with environmental problems head-on, rather than sweeping them under budgets and operating statements. Over the long run, we can't have a healthy economy without a healthy environment.

Marcus/Continued from page 11

the right place. That was necessary, although clearly not sufficient. "We need to learn from the experience of the last ten years," says Quarles, now chairman of the Clean Air Act Project of the industry-sponsored National Environmental Association. "We must reduce complexity, uncertainty, and the general stress injected into the economy by intrusive federal regulations."

This streamlining is also necessary, but not sufficient either. As Victor Weisskopf, professor of physics emeritus at M.I.T., is fond of saying, "Human existence is based on two pillars: compassion and knowledge. Compassion without knowledge is ineffective; knowledge without compassion is inhuman."

A degraded and demoralized EPA is no better for business than an overzealous one. An agency in disarray cannot deliver certainty. A leadership vacuum produces confusion and complexity—it takes time, energy, money, and devotion to achieve streamlining and simplicity.

Moreover, despite all the bad-mouthing, regulation does have a purpose: to correct the inherent shortcomings of the marketplace. According to economist Lester Lave (of the Brookings Institution): "Regulation strives for equity, not efficiency. It *is* expensive, and agencies can address only a few problems a year. Thus, other forces must always pick up where the agencies leave off. But cutting an agency's budget means that its capability is vastly decreased." To many of us, it seems that the capabilities of EPA and several other agencies are decreasing past an acceptable point, and that the administration is making it very difficult for "other forces" to step in.

On the other hand, there may be a silver lining—if unintended—to the cloud. According to one career bureaucrat in EPA (high enough to know the agency well, but not so high as to have been removed by the incoming administration): "The changes are not part of some well-orchestrated conspiracy among EPA's leaders. In fact, there seems to be little structure. The top people clearly want to roll back regulations and avoid new programs, but they are too much separated from the rest of us to do much direct damage. There is a vacuum. And although they do have a good point about inefficiency in government, they don't seem to have a plan." As Hawkins observed at AAAS, "What will probably protect clean air most is the unavoidable requirement that the administration write a specific bill to change the Clean Air Act." □

Steven J. Marcus is managing editor of Technology Review.

Growing Public Action

Fortunately, citizens are well ahead of their current leaders on these issues. Their message, a hopeful one, was recently delivered to Congress by pollster Louis Harris: "By a massive margin of 80 to 17 percent, the public wants no relaxation of existing federal regulation of air pollution." He added that most people vehemently oppose any attempt to reverse the environmental gains of the past ten years, and stressed that this feeling has strengthened during the past year. "This message on the deep desire of the American people to battle pollution is one of the most overwhelming in our 25 years of surveying public opinion."

In a major effort to catalyze public action, 54 citizens' organizations with over 5 million members have formed the Global Tomorrow Coalition. Our purpose is to promote continual monitoring and awareness of global trends that threaten our life-support systems, and to promote action to alter such trends.

We have unanimously petitioned Congress to establish a permanent federal mechanism to provide foresight capability. We are calling for a broad, constantly updated system for gathering trend data, analyzing global implications, and presenting alternatives to both the general public and government decision makers. By systematically using foresight, we can more likely identify and pursue life-supporting paths into the future rather than life-threatening ones.

The government's current position calls to mind a statement by Robert Hamrin, an economist by training, an educator by inclination, and a specialist who takes a broad view: "It is ironic that the new guiding philosophy, supply-side economics, focuses solely on financial capital, neglecting completely the ultimate supply center, matter and energy. The time has come for economists to acknowledge the very crucial fact that although the books of the market system seem to balance and record economic progress, the books of nature, which render the real accounting for the human race, run increasing deficits. If we are to have a true supply-side economics, it will have to incorporate the fact that biological capital is equally as important as financial capital for achieving long-run sustainable growth." □

Russell W. Peterson, who earned his Ph.D. in chemistry from the University of Wisconsin, is president of the National Audubon Society and chairman of the Global Tomorrow Coalition. He was governor of Delaware from 1968 to 1973 and chairman of the President's Council for Environmental Quality from 1973 to 1976. This article is adapted from his talk at the 1982 annual meeting of the American Association for the Advancement of Science in Washington, D.C.

Tweedy/Continued from page 13

spoils easily. This means automated small-scale processing equipment, along with improved transportation methods, are needed to achieve the cost savings promised by full use of the by-products. Also, new diets for livestock should be developed to take advantage of the high energy content of the meal.

Vegetable oils can be burned in pure form as fuel, or they can be blended with diesel fuel. Although both forms are more compatible than alcohols with today's diesel engines, some problems remain. (Whole vegetable oils cannot be burned in spark-ignition engines because they neither vaporize nor ignite properly.) For example, vegetable oils are more viscous than diesel fuels and can cause fuel-flow problems at low temperatures. However, recent studies of a process called "transesterification," which modifies the chemical makeup of the fuel, suggest that this problem may soon be resolved.

Other concerns are poor lubrication, formation of gum and carbon deposits, slightly reduced horsepower, and increased fuel consumption. So while vegetable oil fuels show promise, more research is needed—in refinement techniques, engine modification, and establishment of fuel standards—before they can compete successfully with conventional diesel fuel.

Historically, agricultural products have provided fuel as well as food. In the 1930s, fuel alcohol was produced as an additional market for grain crops. And during World War II, blockades forced Caribbean farmers to burn vegetable oils in their diesel tractors. So it can be done. Although we must be realistic about the limits to potential national contributions of biological liquid fuels, readying alternative fuels for farmers is a legitimate, even essential, goal. □

Robert H. Tweedy is president of the American Society of Agricultural Engineers and manager of strategic business planning for the agricultural equipment sector of Allis-Chalmers Corp., Milwaukee, Wis.

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She can't wear a Ming vase to La Bohème.

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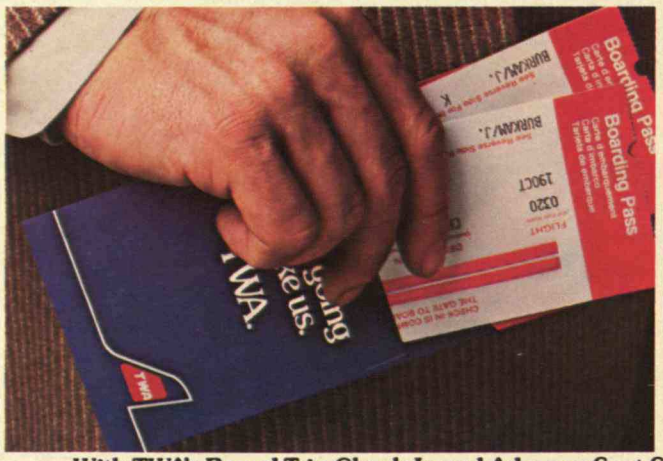

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